DECORATION OF METAL, WOOD GLASS, ETC.

A Book for Manufacturers, Mechanics, Painters, Decorators, and all Workmen in the Fancy Trades : : : :

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RENOVATING METALS AND OTHER MATERIALS BY BRONZING.

Literally, the word "bronzing" means "a brown color," being derived from the Italian word *bronzino,* which signifies "burnt brown"; the term now, however, is taken as meaning the coloring of metals, wood, leather, etc., with a "bronzing" powder, no matter what the color of that powder may be.

Bronze powders are usually dusted on a surface that has been coated with some suitable agglutinant to cause the powder to adhere, in some cases a bronze paint is used, while, in the case of leather articles, a liquid or bronzing fluid is employed. Such a fluid is one of the easiest methods of bronzing because the fluid is similar to a quick-drying varnish, that, when dry, exhibits a "bronzed" effect, which is generally due to the presence of a superabundance of an aniline dye.

Success in the art of bronzing greatly depends on circumstances, such as the temperature of the alloy (metallic bronzing powder) or of the solution, the proportions of the metals used in forming the powder, and the quality of the materials. The moment at which to withdraw the goods, the drying of them and many other little items, require a care and attention in manipulation which experience alone can impart.

To Bronze Alabaster or Plaster Figures.

Size the surface to be bronzed with a suitable size, and when dry touch the prominent parts of the figure or ornament with the No. 1 bronze, and the remainder with No. 2; then soften down the lines of mixture, or contact of the two points, with a badger's hair brush.

No. 1.—Grind equal parts of "Dutch Metal" and the following paint together and thin the mixture with a little oil of turpentine.

No. 2.—Grind Prussian blue, verdigris and ochre, separately with oil, then mix them together in such proportions as will produce a green color.

The above compound is what is known as a bronze "paint!" Instead of using No. 1 for touching up the prominent parts of the figure, Bessemer's gold paint can be employed; then cover the remainder of the figure as before with the paint No. 2.

Aniline Bronzing Fluids.

Take 10 parts of aniline red and 5 parts of aniline purple; dissolve them in 100 parts of methylated spirit at the heat of a waterbath. As soon as the dyes are dissolved, add 5 parts of benzoic acid and raise the temperature of the mixture to the boil and keep it at that heat for 5 to 10 minutes, until in fact the greenish color of the mixture is transformed into a fine light-colored bronze. This fluid is laid on with a brush and is applicable to metals, wood, leather, etc.

Bronzing Fluids.

No. 1.—Ingredients:

50 grains of red aniline,
50 grains of violet aniline,
2 oz. of alcohol,
50 grains of benzoic acid.

Dissolve the aniline colors in a bottle, by the aid of heat (over a waterbath), add the benzoic acid and heat the mixture until its color is of a light brownish bronze.

No. 2.—Brown Bronze Dip—Ingredients:

8 oz. of iron scales,
8 oz. of hydrochloric acid,
½ oz. of arsenic,
½ oz. of zinc (solid).

Mix in a bottle and keep the zinc in the mixture only while the fluid is in use.

No. 3.—Green Bronze Dip—Ingredients:

4 oz. of verditer green,
4 oz. of common salt,
2 oz. of salammoniac,
1 oz. of alum,
16 oz. of French berries,
4 quarts of vinegar.

Boil all these ingredients together.

No. 4.—Olive Green Dip for Brass—Ingredients:

1 oz. of hydrochloric acid,
1½ oz. of nitric acid. Add palladium or titanium.

Dissolve the metal and add 1 pint of the solution to a gallon of soft water.

No. 5.—Black Bronze for Brass.

Dip the article bright in nitric acid, rinse off the acid with clean water and place it in the following mixture until it turns black:

12 lbs. of hydrochloric acid,
1 lb. of sulphate of iron,
1 lb. of pure white arsenic.

Take out the article and rinse it in clean water, dry off in sawdust, polish with blacklead and then coat with green lacquer.

No. 6.—Ingredients:

20 oz. of water,
5 drachms of perchloride of iron.

Have the articles perfectly clean, then dip in the hot solution until the required color is obtained; then dip in clean hot water and dry, then lacquer. The lacquer may be made of shellac varnish colored with dragon's blood, gum and burnt umber.

No. 7.—Ormolu Dipping Acid for Sheet Brass—Ingredients:

6 lbs. of nitrate of potash,
1 gallon of sulphuric acid,
½ pint of nitric acid,
½ pint of hydrochloric acid.

Add the hydrochloric acid last, and stir with a stick.

No. 8.—Parisian Bronze Dip—Ingredients:

1 oz. of salammoniac,
1 oz. of common salt,

2 oz. of liquid ammonia,
2 quarts of vinegar.

Clean the metal, rub the solution over it, then dry off by friction with a brush.

No. 9.—Bronzing Small Articles—Ingredients:

1 part of oxide of iron,
1 part of white arsenic,
12 parts of hydrochloric acid.

Clean the brass well to get rid of lacquer or grease, and apply the above with a brush until the color desired is obtained. Stop the process by oiling well, when it may be varnished or lacquered with clear lacquer.

No. 10.—Bronze Gold—Ingredients:

2½ parts of burnish gold,
2 parts of oxide of copper,
1 part of quicksilver,
¼ part of gold flux.

Having dissolved the copper in nitric acid, it is again separated from the solvent and falls to the bottom of the vessel by the addition of iron. The precipitate of copper may be decreased or increased at discretion, which modifies the color of the bronze according to the proportion of burnish gold contained in the mixture. This compound is chiefly used for ornamenting the handles and heads of jars, vases and similar articles, and occasionally mixed with burnished gold.

No. 11.—Green Bronze—Ingredients:

2 oz. of nitrate of iron,
2 oz. of hyposulphite of soda,
1 pint of water.

Immerse the articles in the fluid until of the re-

quired tone of color. Almost any shade from brown to red can be obtained from this fluid; then wash well with water and brush.

No. 12.—To Bronze Castings (by Dipping).

Pickle the castings in sulphuric acid and water (1 to 10), scour with sand, and then dip for an instant in a solution of copper sulphate, 3 oz., sulphuric acid, 5 oz., 1 gallon of water. Rinse in cold water and dry in sawdust.

Bronze on Feathers.

They are chiefly goose feathers and wings of pigeons which appear covered with gold and silver. The process is very simple. The feather is dipped in bronze powder and rubbed with a piece of wash leather or chamois. In course of wearing, however, the bronze is very easily detached. To prevent this, the feather before being dipped in the bronze powder is taken through gum water, pressed nearly dry between cloths and in its slightly adhesive state is treated with bronze powder. Partially bronzed feathers and wings are produced by covering those parts which are to remain plain with pasteboard and the bronze powder is rubbed upon the rest with a feather. Of course varied effects may be produced by drying the feathers with aniline colors, etc., prior to the application of the bronze.

Bronzing Liquids for Gun Barrels.

No. 1.—Nitric acid, ½ oz., sweet spirits of nitre, ½ oz., spirits of wine, 1 oz., sulphate of copper, 2 oz., water, 30 oz., tincture of muriate of iron, 1 oz.; mix.

No. 2.—1 oz. of sulphate of copper, 1 oz. of sweet

spirits of nitre, 1 oz. of water; mix. In a few days it will be ready to use.

No. 3.—3 oz. of sweet spirits of nitre, 1½ oz. of gum benzoin, ½ oz. of tincture of muriate of iron, 2 drachms of sulphate of copper, ½ oz. of spirits of wine; mix, and add 2 lbs. of soft water.

No. 4.—Tincture of muriate of iron, ½ oz., spirits of nitric ether, ½ oz., sulphate of copper, 2 scruples, rain water, ½ pint.

The above are applied with a sponge after cleaning the barrel with lime and water. When dry, they are polished with a stiff brush or iron scratch-brush.

Bronzing Inlaid Work.

A method for decorating inlaid work is in the use of a bronzing liquid, consisting of a liquid composition formed by combining metallic gilding or bronze powder with collodion, which composition is capable of being applied as a bronze liquid to surfaces of wood, iron, or any solid material for the purpose of coating the same for decoration or preservation.

To Bronze Pipes Used for Steam Heating.

Use ordinary chrome yellow for painting the pipes. When this is nearly dry, rub on gold bronze powder with a piece of fur. Varnish with thin copal or mastic varnish when thoroughly dry.

To Bronze Iron.

The following is a method of giving to iron the appearance of bronze without coating it with any metal

or alloy. The article to be treated is first cleaned and then coated with a uniform film of some vegetable oil; this done, it is exposed in a furnace to the action of a high temperature, which, however, must not be strong enough to carbonize the oil. In this way the cast-iron absorbs oxygen at the moment the oil is decomposed, and there is formed at the surface a thin coat of brown oxide, which adheres very strongly to the metal and will admit of a high polish, giving it the appearance of fine bronze.

To Bronze Iron Castings.

The castings must be first thoroughly cleaned, then immersed in a solution of sulphate of copper, when the castings will acquire a coat of the copper. Wash in water.

Bronzing Articles Made of Iron Wire.

Clean the wire perfectly, then immerse it in a solution of sulphate of copper until covered with a coating of metallic copper. Then wash and immerse the articles in the following solution:

2 oz. of verdigris,
1 oz. of salammoniac,
1 pint of vinegar.

Dilute with water until the fluid tastes slightly metallic; then boil for a few minutes and filter. The articles are steeped in this liquid at the boiling point until the desired color is produced, but they should not be kept in too long. When taken out, wash in hot water and dry.

Size for Bronzing Powder for Iron.

To 1 pint of methylated spirit or "finish," add 4 oz. of shellac and ½ oz. of gum benzoin. Allow the mixture to digest in a warm place, shaking it occasionally. When the solids are dissolved, allow the fluid to stand in a cool place for the dregs to settle. Then pour off the clear portion for fine work, reserving the sediment for coarser work by mixing it with more alcohol and straining. Add the bronze powder in sufficient quantity and apply the compound to the clean, warm iron, using a soft brush. Repeat after drying, if necessary. Thin with alcohol, if desirable, to avoid wrinkles and brush marks. Varnish over all.

METHODS OF BRONZING ORNAMENTS OF COPPER, ELECTROTYPES, ETC.

No. 1.—Thoroughly clean and polish the surface of the article, and with a brush apply the common crocus powder, previously made into a paste with water. When dry, place it in an iron ladle or on a common fire shovel over a clear fire for about one minute. When sufficiently cool, polish with a plate brush. By this process a bronze similar to that on urns is produced, the shade depending on the duration of the exposure to the fire.

No. 2.—By substituting finely-powdered plumbago for the crocus powder in the above process, a beautiful deep and permanent bronze appearance is produced.

No. 3.—Rub the metal with a solution of potassium sulphide (liver of sulphur); then dry. This process produces the appearance of antique bronze very closely.

No. 4.—Dissolve 2 oz. of verdigris in vinegar and make into a paste with 2 oz. of vermilion, 5 oz. of salammoniac, 5 oz. of alum. Spread this paste over the surface of the copper (previously well cleaned and brightened uniformly), warm the article by the fire, and afterwards wash well and dry. Then, if the tint be not deep enough, the process may be repeated. The addition of a little sulphate of copper inclines the color to a chestnut brown, and a little borax to a yellowish brown.

No. 5.—Dissolve 1 oz. of salammoniac, 3 oz. of cream of tartar, 6 oz. of common salt in 1 pint of hot water. Then add 2 oz. of nitrate of copper dissolved in ½ pint of water. Mix well and apply the fluid repeatedly to the article. Work in a damp place, using a brush for laying on the fluid.

Bronze Imitation of Mildew.

Dissolve equal weights of nitrate of iron and hyposulphite of soda in 8 times their weight of water, and steep the articles in this fluid until of the right tint. Then wash well with water, dry and brush (1 part of chloride of iron to 2 parts of water imparts to brass a fine antique green). Brush well and lacquer with pale gold or lacquer. Polish with oil.

To Bronze Paper.

Gum is substituted for drying oil in bronzing paper. When it is dry, the paper is submitted to the action of the burnisher, which imparts great brilliancy to it.

Renovating Metals by Browning.

The following processes are generally used for the browning of sporting guns and rifles:

No. 1.—Scour the metal brightly with fine glass paper, heat over a fire, then brush the metal with this solution:

5% crystallized acetate of copper,
7% chloride of ammonium,
3% acetic acid, diluted,
85% distilled water.

Apply this to the metal and then rub with 1 part of wax dissolved in 4 parts of oil of turpentine.

No. 2.—Ingredients:

1½ oz. of spirits of wine,
1½ oz. of sweet spirits of nitre,
1 oz. of sulphate of copper,
¾ oz. of nitric acid.

Mix and dissolve in 1 quart of warm water and keep in a glass bottle. Clean the barrel well with caustic soda solution to remove all grease or oil; then clean the surface of all stains and marks by emery paper or cloth, so as to produce an even, bright surface for the acid to act on, and one without finger-marks. Stop up the bore and vent with wooden plugs. Then apply the mixture to every part with a sponge or rag and expose to the air for 24 hours, when the loose rust should be rubbed off with a steel scratch-brush. Use the mixture and the scratch-brush twice or more, if necessary, and finally wash in boiling water, dry quickly and wipe with linseed oil, or varnish with shellac.

Browning for Twist Gun Barrels.

Ingredients:

½ oz. of black brimstone,
1½ oz. of tincture of steel, or the unmedicated tincture of iron,
1 oz. of sulphate of copper,
½ oz. of corrosive sublimate,
½ oz. of sulphate of iron,
2 drachms of nitric acid,
1½ oz. of spirits of nitre.

Add 3 oz. of soft water and put in bottles for use. This mixture causes the twist of the barrel to be visible after application.

Browning Ordinary Gun Barrels.

Wet a piece of rag with chloride of antimony, dip it in olive oil and rub over the barrel. In 48 hours it will be covered with a fine coat of rust. Then rub the barrel with a fine steel scratch-brush and wipe with a rag dipped in boiled linseed oil.

Browning Iron and Steel.

Dissolve in 4 parts of water, 2 parts of crystallized iron chloride, 2 parts of chloride of antimony and 1 part of gallic acid, and apply the solution with a cloth or rag to the article and dry it in the air. Repeat this any number of times, according to the depth of color it is desired to obtain. Wash with water, then dry, and finally rub the article over with boiled linseed oil. The metal thus receives a brown color and resists moisture. The antimony chloride should be as little acid as possible.

Bronzing Powders.

These powders are made of metallic alloys, beaten into leaf or foil, which is subsequently reduced to a powder form by rubbing up with honey or gum water and then washing away the water and collecting the powder.

Gold Bronze Powder.

This is made by grinding gold leaf with honey as just described. "German" gold is a yellow alloy leaf

similarly treated. Silver bronze is made in the same way from silver leaf or else by dissolving silver in nitric acid and precipitating by means of polished copper put into the fluid.

Mosaic Gold.

Mosaic gold is made by incorporating and grinding together:

16 parts of tin,
7 parts of flowers of sulphur,
8 parts of mercury,
8 parts of salammoniac.

This mixture is put into a clay crucible and a cover put on. Then the mixture is heated until it sublimes and a flaky gold-colored powder remains in the matrass.

Copper Bronze.

Copper bronze is obtained by saturating nitrous acid with copper and then precipitating the copper by putting strips of iron in the fluid.

An Imitation Gold Powder.

This is made by grinding into a paste with oil and then fusing:

4 oz. putty powder (tin oxide),
2 oz. borax,
8 oz. verdigris,
2 oz. nitrate of potash,
¼ oz. bichloride of mercury.

A Red-Gold Powder.

A red-gold powder is made by calcining at a white heat for 20 minutes:

10 oz. of sulphate of copper,
6 oz. of carbonate of soda.

Mix and incorporate by heat. Then cool, reduce to powder and add 15 oz. of copper filings. Mix and then keep at white heat as stated. Then cool, powder, wash and dry.

Bronzing Plaster Casts.

No. 1.—Coat the figure with isinglass size until the surface remains in a moist state and will absorb no more. Then touch it lightly and sparingly with gold size and put it away in a clean, dry place for 48 hours. Touch the figure all over with bronze powder and after the lapse of 24 hours brush off all the loose powder, particularly from the projecting parts of the figure.

No. 2.—The following is given as a process used in France for this purpose: Linseed-oil soap is made by saponifying the oil with caustic soda and precipitating the soap with salt. It is separated, dissolved in rain water, and a mixture in solution of 4 parts of blue vitriol and 1 part copperas is added as long as a precipitate forms. This is filtered out, washed and dried and $8\frac{3}{4}$ oz. are applied with 1 lb. of quick-drying varnish and $5\frac{3}{4}$ oz. of white wax. This is applied to the surface, previously heated, and is baked in if necessary. The high parts are touched up with a bronze powder. As a simpler process, shellac the bust, then gild it with bronze powder, and varnish.

To Bronze Rifles.

Take the breeches out and stop the orifices at each end; rub barrels over with hot lime to take off all grease, and then clean them carefully. Do not touch the barrels with your hands. Get from a chemist 60 drops of sweet spirits of nitre, 60 drops of tincture of iron, 16 grains of sublimate of mercury, 16 grains of green copperas, 16 grains of blue vitriol; add 4 tablespoonfuls of water, then, with a pad of cotton wool, wet the barrels and leave them until well rusted. Polish with steel brush, to be obtained from a gunmaker; repeat ten times, then wash with boiling water and oil. Be careful with stain as it is deadly poison.

Bronzing Wood.

No. 1.—The wood is first covered with a uniform coating of glue or of drying oil, and when nearly dry the bronze powder, contained in a small bag, is dusted over it. The surface of the object is afterwards rubbed with a piece of moist rag, or the bronze powder may be previously mixed with the drying oil and applied with a brush.

No. 2.—First coat the wood with a mixture of size and lampblack, then apply two coats of the green-colored size in the last recipe and lastly with bronze powder, such as powdered Dutch foil, mosaic gold, etc., laid on with a brush. Finish with a thin solution of Castile soap and when dry rub it with a soft woolen cloth.

Bronzing Tin Castings.

When clean, wash them with a mixture of 1 part each of sulphate of iron and copper in 20 parts of water; dry, and again wash with 11 parts of distilled vinegar and 4 parts of verdigris. When dry, polish with colcothar.

To Bronze Zinc.

First give a coat of brass (by electrolytic action), then wet with a cloth dipped in copper protochloride dissolved in hydrochloric acid. When dry, brush with a mixture of equal parts of iron peroxide and plumbago mixed up with a little essence of turpentine. Varnish with thin copal varnish.

To Give Sheet Tin and Tinned Articles the Red Color of Copper.

Dissolve 18 drachms of sulphate of copper in soft water until the water is saturated, and then add 80 to 100 drops of sulphuric acid. Cleanse the tinware with onion juice, then brush it with the above fluid. When dry, rub with chalk and rinse.

METALLIC COATINGS, DIPS, STAINS, ETC.

Apparatus and Process for Coating Tools.

Metallic tools and other articles, particularly those consisting of iron and steel which are used in laboratories or other workshops where acid vapors are of frequent occurrence, can be protected from rust with a black shining coat which resists acids and is but little affected even by a low red heat, as follows: Have a sheet-iron box constructed large enough to hold all the tools, etc., to be coated, and provided with a false bottom of wire netting. Underneath this is placed a layer of crushed blacksmiths' coal about $\frac{1}{3}$ of an inch deep; then place the tools, which must be entirely free from rust, clean and polished, upon the wire net. The box is then covered and set on a strong fire, which causes the coal to give off tarry constituents, and the heat is continued until the bottom of the box is at a red heat. When all evolution of gas has ceased, the box is allowed to become cold and the tools are taken out and will be found covered with a beautiful glossy coat. Tongs, shears, pincers, etc., so coated, keep in good condition for many months, even in places where the air is constantly mixed with acid vapors.

Bronzing Copper.

Dissolve 30 parts of carbonate or hydrochlorate of ammonium and 10 parts each of common salt, cream of

tartar and acetate of copper in 100 parts of acetic acid of moderate concentration, or in 200 parts of strong vinegar, and add a little water. When an intimate mixture has been obtained, smear the copper object with it and let it dry at an ordinary temperature for 24 or 48 hours. At the end of that time the object will be found to be entirely covered with verdigris, presenting various tints. Then brush the whole and especially the reliefs with a waxed brush, and, if necessary, set off the high reliefs with hermatite or chrome yellow or other suitable colors. Light touches with ammonia give a blue color to the green portions. Carbonate of ammonium deepens the color of the part on which it is laid.

Gilding of Steel.

Dissolve pure gold in nitro-muriatic acid, and evaporate the solution to dryness to expel the excess of acid. Dissolve the residue in pure water and add 3 times the quantity of sulphuric ether. Then shake the mixture in a well-stoppered bottle, until, when standing quietly, the ether appears of a golden-yellow color and the water beneath it is entirely clear. Polished articles of steel plunged into the solution are instantly and beautifully gilded. By protecting portions of the surface of the articles with varnish or lacquer, beautiful designs can be produced. If the gilding should not turn out well at first, dilute the liquid with ether. Care should be taken not to execute the work near a light or fire.

Gold and Orange Stain for Brass.

Dip the articles in a mixture of 3 drachms of caustic soda, 2 oz. of water, and 5½ drachms of moist carbonate of copper. The shades of color appear in a few minutes and the progress can be readily observed. After obtaining the desired shade of color, rinse the articles in water and dry in fine sawdust.

Green Bronzing.

The repeated applications to copper or brass of alternate washes of dilute acetic acid and exposure to the fumes of ammonia will give a very antique-looking bronze, but a quick method of producing a similar appearance is often desirable. To this end the articles may be immersed in a solution of 1 part of perchloride of iron in 2 parts of water. The shade becomes darker with the length of immersion. Or the articles may be boiled in a strong solution of nitrate of copper, or may be immersed in a solution of 2 oz. of nitrate of iron and 22 oz. of hyposulphite of sodium in 1 pint of water. Washing, drying and burnishing completes the process.

To Cleanse Brass.

Dip the articles in a mixture of 1 part of nitric acid and ½ part of sulphuric acid, rinse in water and finally rub with sawdust. If greasy, dip the brass first in a boiling-hot solution of potash lye.

Process of Producing a Bronzed Surface on Iron.

The cleansed objects are exposed to the vapors of a heated mixture of equal parts of concentrated hydrochloric acid and nitric acid for a few minutes, and heated to a temperature of from 572 to 562° F., the heating being continued until the bronze color appears. The objects are then cooled, rubbed with vaseline and heated until the latter begins to decompose, the operation being repeated once more. A bronze-colored oxide coating is obtained by using acetic acid in conjunction with the above-mentioned acids. By varying the proportions of the different acids, it is possible to obtain light and dark shades. Iron bars coated in this manner and exposed for a year to the atmosphere of a laboratory, remain unchanged and without the slightest sign of corrosion.

Method of Painting on Zinc.

This metal is a very difficult one to paint. Most paints fail to adhere, but by following the method here given, the metal will take almost any kind of paint. Make a mixture of 1 part each of nitrate of copper and salammoniac dissolved in 64 parts of water. To this mixture add 1 part of commercial hydrochloric acid. Brush this fluid over the plate of zinc. After 12 or 24 hours it dries a dullish gray color. Paint can then be laid on this metal and will perfectly adhere.

Another method is as follows: Into some hydrochloric acid of full strength, drop some pieces of zinc until effervescence ceases. Add an equal quantity of water and, with a sponge tied to a stick, wash over

every part of the surface to be painted. This roughens the surface and takes off that sort of greasiness which prevents paint from adhering. After the acid has remained a short time, wash it over with water or diluted vinegar, dry off and paint.

Bronzing Amalgam.

Take equal parts of mercury, tin, sulphur and sal-ammoniac. First melt the tin, then pour the mercury into it. When the combination thus formed has become cold, rub it together with the sulphur and sal-ammoniac. Place the mixture in a crucible and heat until all the powders in the crucible become gold-colored and fumes of mercury begin to arise.

Copper-Colored Bronze Powder.

Dissolve some metallic copper in nitric acid (using a bottle well corked and placed in the open air, because the dense, ruddy fumes of nitrogen oxides that are evolved are dangerously poisonous to inhale) until the acid is saturated with the metal (*i.e.,* will not dissolve any more). Then put a small piece of iron in the solution and electrolytic action will be set up whereby the copper will be deposited as a pure metallic precipitate. Calcine the precipitate, wash it carefully, then dry and put in well-closed bottles for use.

Commercial Bronze Powders.

Commercial bronze powders are prepared by beating metal alloys to very thin sheets in a similar way to gold leaf, and then rubbing this foil on a stone with honey

or thick gum water until the metal is broken into fine powder, when the adhesive is washed away and the residue collected in a filter. The alloys employed consist of the following materials:

Pale yellow bronze powder:

88·33% copper,
16·69% zinc,
0.16% iron.

Bright yellow:

84·50% copper,
15·30% zinc,
0·07% iron.

Orange:

98·93% copper,
0·73% zinc,
0·08% iron.

Green:

84·32% copper,
15·02% zinc,
0·03% iron,
Trace of tin.

Copper-red:

99·90% copper,
Trace of tin.

Reddish-yellow:

90·00% copper,
0·80% zinc,
0·20% iron.

Violet:

8-22% copper,
0-50% zinc,
0-30% iron,
Trace of tin.

White:

2-39% copper,
0-56% iron,
66-46% tin.

Bronze for Plaster of Paris Figures.

The mass used for this purpose is prepared as follows: Linseed oil is boiled to a soap with soda lye, common salt being added until the soap separates. This soap is then dissolved in soft water and mixed with a solution of 4 parts of sulphate of copper and 1 part of sulphate of iron until a precipitate is no longer produced. The soap is washed and used for preparing the antique green connection with a varnish prepared from $12\frac{3}{4}$ oz. of litharge and $3\frac{1}{2}$ lbs. of linseed oil and wax. Now melt together 1 lb. of varnish and $8\frac{3}{4}$ oz. of the bronze soap and $5\frac{1}{4}$ oz. of white wax. Apply this to the figure (which should be heated previously to 190° F.) by means of a brush. If necessary, put the plaster figure in a heated box until it is thoroughly penetrated with the color. The raised parts are rubbed with bronze powder.

Renovating Metals by Gilding, Platinizing, Etc.

To give a coating of nickel on iron without the use of electricity: Take a solution of chloride of zinc of

5 to 10% strength and add sufficient salt to give the usual nickel-colored bath; then immerse the iron article (cleaned and free from grease) in this compound for ½ hour.

Platinizing Metal.

Take a solution of platinum chloride and slowly add some salammoniac. Collect the precipitate that is thrown down, mix this into a paste with finely-powdered borate of lead and a little water. Cleanse the metal article and then lay on a coating of this mixture and submit the article to a strong heat in a sheet-iron muffle.

General Process of Platinizing Metals.

Optical instruments, etc., are platinized by boiling them in a solution of ¾ oz. of ammonia chloride, chloride of platinum, and 3 oz. of salammoniac in 14 oz. of water. This solution may also be used for copper and brass articles.

Platinum Plating.

Platinum plating is usually carried out by processes that are carefully guarded by the operators, but the following data will be useful: First, there are two methods of platinum plating: (1) By dipping without the use of a battery, *i.e.,* boiling; (2) by electrolysis. Copper and its alloys are best adapted for platinizing, as the platinum adheres well to them, but not very well to iron, zinc, tin and lead. The following solution is recommended for platinizing by the first method:

One part of pure chloride of platinum in solid form and as neutral as possible, and 10 parts of antimony, pure sodium hydrate is then carefully poured on the sodium lye. When the two solutions have become thoroughly mixed, add ammonia until the mixture shows a perceptible odor of it. The bath is then heated to the boiling point and the article (thoroughly cleansed) is dipped into it. As soon as it has acquired a white, brilliant coating, rinse in hot water, dry in sawdust, and, if necessary, again dip. This coating, no matter how well it may look, will necessarily be very thin and not capable of resisting acids, scouring, etc.

The following is a good method of carrying out the second process:

Dissolve 10 drachms of pure chloride of platinum in 7 oz. of water; then dissolve 12 oz. of ammonia phosphate in 7 oz. of water. Mix this with the solution of platinum, disregarding the precipitate which is formed. In the meanwhile raise 10½ oz. of water and 3½ oz. of sodium phosphate to the boiling point and add, while this is boiling, the thoroughly-shaken solution above described. Continue to boil the mixture until the fluid is entirely clear and the odor of ammonia entirely disappears and the solution, at first alkaline, ceases to impart a blue color to reddened litmus paper. When this bath has cooled and has been filtered, it is ready for use. It requires a strong, constant current and a large anode. According to one authority, copper and brass can be electroplated with platinum to any thickness by boiling the article from time to time in the solution of platinum and scouring this with whiting. The salt

of platinum used is prepared in the following manner: 100 parts of potash hydrate dissolved in water are added to a solution in water of the chloride of platinum obtained from 100 parts of metallic platinum. The minute yellow crystals of platinum chloride which are formed are heated with 20 parts of oxalic acid in a porcelain vessel until they disappear; and when the solution is complete, 300 parts more of potassium chloride dissolved in water are added.

Plating With Aluminum.

Dissolve any desired quantity of aluminum salt, such as the sulphate, chlorate, nitrate, acetate, cyanide, etc., in distilled water and concentrate the solution to 20 Beaume in a suitable vessel to hold the articles to be plated. The battery to be used should be 3 pairs of Bunsen's cells with the wires coupled up for intensity and an anode of aluminum attached to the negative wires. The solution should be slightly acidulated with its approximate acid heated to 140° F. and kept at that temperature during the operation.

To Gild Copper by Boiling.

Take a liquid amalgam consisting of 4 parts of mercury, 2 parts of zinc and 1 oz. of gold. Mix this amalgam with 8 parts of hydrochloric acid and add 1 oz. of salt of tartar; cleanse the copper thoroughly with nitric acid and then boil it in the fluid until it has assumed a bright gold color.

To Increase the Brilliance of Gilded or Plated Ware.

Convert the following ingredients to a very fine powder:

5 oz. of sulphur,
2 oz. of alum,
1 oz. of turmeric,
2 oz. of arsenic,
1 oz. of native antimony.

Separately prepare the following liquid:

3 oz. of salammoniac,
1 oz. of common salt,
6 oz. of vinegar,
26 oz. of water.

Boil the fluid for half an hour, and then steep the article in it until the color is sufficiently brilliant.

Chemical Fluids for Coloring Metals.

These liquids are used simply by dipping the metal article in them for a sufficiently long time.

The following solutions are for coloring brass, simply by immersion:

No. 1.—Brown tones to black:

1 pint of water,
5 drachms of nitrate of iron.

No. 2.—Brown and all shades to black:

1 pint of water,
5 drachms of protochloride of iron.

No. 3.—Brown and all tones to red:

1 pint of water,
16 drachms of nitrate of iron,
16 drachms of hyposulphite of soda.

No. 4.—Brown and every shade to red:

1 pint of water,
16 drachms of hyposulphite of soda,
1 drachm of nitric acid.

No. 5.—Brownish-red:

1 pint of water,
1 oz. of nitrate of copper,
1 oz. of oxalic acid.

No. 6.—Brownish-red:

1 pint of a solution of ferrocyanide of potash,
3 drachms of nitric acid.

No. 7.—Dark-brown:

1 pint of water,
1 oz. of cyanide of potassium,
4 drachms of nitric acid.

No. 8.—Yellow to red:

1 pint of water,
¼ oz. of terchloride of arsenic,
6 drachms of pearlash solution.

No. 9.—Orange:

1 pint of water,
1 drachm of a solution of sulphide of potash.

No. 10.—Olive-green:

2 pints of water,
2 drachms of perchloride of iron.

No. 11.—Blue:

1 pint of water,
2 drachms of hyposulphite of soda.

No. 12.—Slate:

1 pint of water,
5 drachms of perchloride of iron,
2 drachms of sulphocyanide of potash.

No. 13.—Steel-gray:

1 pint of water,
1 oz. of tersulphide of arsenic.

No. 14.—Black:

1 pint of water,
4 drachms of perchloride of iron,
10 drachms of tersulphide of arsenic.

N. B.—No. 6 must be boiled and cooled. It is slow in action, being about one hour in producing the color. No. 13 must be used at 180° F. or over.

Chemical Solution for Coating Copper by Simple Immersion.

No. 1.—Dark-brown drab:

1 pint of water,
5 drachms of nitrate of iron,
2 drachms of sulphocyanide of potash.

No. 2.—Dark-brown drab:

1 pint of water,
1 oz. of sulphate of copper,
1 oz. of hyposulphite of soda,
2 drachms of hydrochloric acid.

No. 3.—Brown and every shade to black:

1 pint of water,
5 drachms of nitrate of iron.

No. 4.—Bright red:
1 pint of water,
2 drachms of sulphide of arsenic,
1 oz. of pearlash.

No. 5.—Red and every shade to black:
1 pint of water,
1 drachm of pearlash,
1 drachm of sulphur.

No. 6.—Steel-gray (use at 180° F.):
1 pint of water,
1 drachm of chloride of arsenic.

Chemical Coloring Solution for Zinc.

No. 1.—Black:
1 pint of water,
15 drachms of nitric of iron.

No. 2.—Black:
1 pint of water,
1 drachm of protochloride of tin.

No. 3.—Dark-gray:
1 pint of water,
1 drachm of protochloride of tin,
1 drachm of sulphocyanide of potash.

No. 4.—Dark-gray:
2 pints of water,
1 drachm of sulphate of copper,
1 drachm of chloride of iron.

N. B.—Make this to the consistency of cream.

No. 5.—Green-gray:
2 pints of water,
1 drachm of chloride of iron.

No. 6.—Copper color:

1 pint of water,
4 drachms of sulphate of copper,
4 drachms of pearlash.

No. 7.—Copper color (with agitation):

1 pint of water,
8 drachms of sulphate of copper,
8 drachms of hyposulphite of soda.

Coloring by Sulphides of Metals.

Metals may be colored quickly by forming on the surface a coating of a thin film of a sulphide. By an immersion of five minutes, brass articles may be coated with colors varying from gold to copper red, then to carmine, dark red, and from a light to a blue white and at last a reddish white, according to the thickness of the coat, which depends on the length of time the metal remains in the solution used. The color possesses a very good lustre and if the article to be colored has been previously well cleaned by means of acids and alkalies, they adhere so firmly that they may be burnished. To prepare the solvent, dissolve 1½ oz. of hyposulphite of soda and 1½ oz. of acetate of lead, also dissolved in 1 pint of water. Mix the two fluids and heat to 190 to 200° F. It decomposes slowly and precipitates sulphate of lead in brown globules. If metal is present, put the sulphate of lead deposited therein, and, according to the thickness of the deposit, the above colors are produced. To produce an even coloration, the surface must be cleansed. When heated with this solution it takes a steel-blue, zinc or brown color. In the case of

copper articles, the pure gold color does not appear. If instead of the acetate of lead an equal weight of sulphuric acid is added to the sodium hyposulphite, and the process carried on as before, the brass becomes coated, first with a very beautiful red, which is followed by a green and changes finally to a splendid brown with green and red iridiscium. The metal should be thoroughly cleaned of oil and grease before immersion in the liquid and only by practice can particular colors be obtained. Then when the article is lifted from the water allow the transferred film to dry in a warm room; it will then become hard-lustred and have the iridescence of mother-o'-pearl.

DRAWINGS.

Drawings, to Fix.

No. 1.—Immerse the drawings in skimmed milk. A special fixative is sold for the purpose by dealers in art materials. Collodion, if very thin, might be used with advantage; it is often used for manuscripts.

No. 2.—Flow with very thin collodion.

No. 3.—Two tablespoonfuls of rice boiled in 1 pint of water; strain and pass the drawing quickly through the fluid. Use a large flat dish for the liquid.

No. 4.—Prepare water-starch in the manner of the laundress and of such a strength to form a jelly when cold. Then apply with a soft camel's-hair brush as in varnishing. The same may be done with thin cold isinglass water or size or rice water.

Mounted Drawings on Linen.

The linen or calico is first stretched by tacking it tightly on a frame or stretcher. It is then thoroughly coated with thick size and left until nearly dry. The sheet of paper to be mounted requires to be well covered with paste. This will be best if done twice, allowing the first coat about 10 minutes to soak into the paper. After applying the second coat, place the paper on the linen and dab it all over with a clean cloth. Trim off when thoroughly dry.

Drawings, to Mount and Varnish.

Paste the drawing on the background. Flour paste is as good as any, and, when it is dry, size the surface with a solution of gum arabic or white glue. When that is dry use any varnish you please. For a delicate picture or drawing, dammar varnish is the best, but it must be applied evenly to secure a smooth surface.

Drawing on Glass.

To write or draw on glass it is necessary to impart to the surface a certain degree of roughness. This may be done by grinding or etching, but much more easily by applying some appropriate varnish.

A good matt varnish is made by dissolving in 2 oz. of ether, 90 grams of sandarac and 20 grams of mastic, adding ½ to 1½ oz. of benzol, according to the fineness of the matt required. The varnish is applied to the cold plate after it has set. The glass may be heated to ensure a firm and even grain. To render the glass again transparent after writing upon it, apply with a brush a solution of sugar or gum acacia.

To Waterproof Crayon and Charcoal Drawings, Maps and Prints.

Cut up some gutta-percha and dissolve it in a large bulk of ether in a closed bottle stood in a vessel of hot water. Pour off the fluid from the dregs and apply the clear liquid to the drawing or surface to be preserved, laying it on lightly with a flat varnish brush. It forms a transparent waterproofing film for the surface.

DYES AND FOILS.

Marble, to Stain or Dye.

No. 1.—In staining marble, it is necessary to heat it, but not so hot as to injure it, the proper heat being that at which the colors nearly boil. Blue is produced with aniline Indigo dye; red, by dragon's blood in alcohol; yellow, by gamboge in alcohol; gold color, by salammoniac, ammonium chloride, zinc sulphate and verdigris in equal parts; green, sap green in alcohol, potassium hydroxide; brown, tincture of logwood; crimson, by a solution of alkanet root in turpentine. Black spots may be produced with silver nitrate.

No. 2.—Marble can be stained different colors by the following substances: Blue, solution of litmus; green, wax colored with verdigris; yellow, tincture of gamboge or turmeric; red, tincture of alkanet or dragon's blood; gold, equal parts of verdigris, salammoniac and sulphate of zinc in fine powder.

To Dye Feathers with Aniline Colors.

These dyes act on organic fibres of all kinds, consequently the feathers are easily dyed by simply steeping them in a solution, more or less of the selected dye, usually with a lukewarm temperature. The dye solvent should be strained or filtered before dipping the feathers

and should be waved about in the dye liquor, then rinsed in cold water, dried and curled.

For rose-red colors use a weak solution of fushine and a strong solution of carmine. For a greenish-blue, use Blue de Lyons. For a green, use a strong solution of aniline green. For a yellow, use a solution of yellow corallin. To give a bronzed appearance to the tips of the feathers, proceed as follows: Dissolve blue or red patent violet in 90% alcohol heated over a water bath. After the feathers have been dyed and oiled, brush the solution over the tips. This spirit quickly evaporates, leaving a bronzed appearance. If violet solution is in water, instead of spirit, the bronzing will rub off.

To Dye Mother-o'-Pearl.

Wash the thin plates of pearl in a lukewarm solution of potash. Then place them in a concentrated aqueous solution of the coloring matter and let them stand in a warm place, frequently stirring them. If the dye is to penetrate to some depth, the plates should remain in the coloring matter for two weeks, then rinsed and dried.

Fancy Coloring of Metallic Foils for Backing Imitation Precious Stones.

The word "foil" is from the Latin *folium* or from the French *feuille,* meaning a leaf; therefore metallic foils refer to thin leaves of polished metal which are used for putting under imitation precious stones or "paste" to heighten the color or effect of them. Formerly foils were made of copper, tinned copper and tin and silvered

copper, but the latter is that wholly used for superior work at the present day. There are two kinds of foils employed, viz.: white, for diamonds and mock diamonds, and colored for the other gems. The latter is prepared by varnishing the former. By their judicious use the color of a stone may be often modified. Thus, by placing a yellow foil under a green stone that turns too much on the blue, or a red turning too much on the crimson, the hues will be brightened.

No. 1.—White or Common Foil.—This is made by coating a plate of copper with a layer of silver and then rolling it into thin sheets in the flatting mill. The foil is then highly polished or varnished.

No. 2.—Colored Foils.—These are made by coloring the preceding foil, highly polished, with certain transparent solutions or varnishes. The following produce beautiful colored effects when judiciously employed with oil.

No. 3.—Blue.—Prussian blue (preferably Turnbull's) ground with pale, quick-drying oil. This is used to deepen the color of sapphires. It may be diluted with oil.

No. 4.—Green.—(*a*) Pale shellac, dissolved in alcohol and tinged green by dissolving verdigris or acetate of copper in it. (*b*) Sesquiferro-cyanide of iron and bichromate of potash, ½ oz. of each. Grind them with a stone and muller to a fine powder, add 2 oz. of clean mastic in fine powder, grind again, add a little pyroxilic spirit, and grind them until the mass becomes homogeneous and of a fine transparent green. The beauty increases with the length of the grinding. The predomi-

nance of the bichromate turns it on the yellowish green, that of the salt of iron on the bluish green. For use, it is to be thinned with pyroxilic spirit. This compound is used for emeralds. It may be brightened by adding a little yellow varnish.

No. 5.—Yellow.—(*a*) Various shades of yellow may be produced by tinging a weak alcoholic solution of shellac or mastic, by digesting turpentine, annotto, saffron, or soccotrine aloes therein. The former is the brightest and most fit for topazes. (*b*) Digest hay saffron in five or six times its weight of boiling water until the latter becomes sufficiently colored, filter and add a little solution of gum or isinglass. When dry, a coating of spirit varnish should be applied.

No. 6.—Red.—Carmine dissolved in spirits of hartshorn (liquid ammonia) or a weak solution of salt of tar and gum added as above.

No. 7.—Vinegar Garnet.—Orange lake finely tempered with shellac varnish.

No. 8.—Garnet.—Dragon's blood dissolved in rectified spirits of wine.

No. 9.—Amethyst.—Lake and Prussian blue finely ground in pale drying oil.

No. 10.—Aquamarine.—Verdigris tempered in shellac varnish (alcoholic) with a little Prussian blue.

No. 11.—Ruby.—(*a*) Lake or carmine ground in isinglass. (*b*) Lake ground in shellac varnish. This is used when the color turns on the purple. (*c*) Bright lake ground in oil; this is used when the color turns on the scarlet or orange.

No. 12.—Diamond.—(*a*) Cover the inside of the socket in which the stone or paste is to be set with tinfoil by means of a little stiff gum or size. When dry, polish the surface, heat the socket, fill it with warm quicksilver, let it rest for two or three minutes, then pour it out and gently fit in the stone; lastly, well close the work around the stone to prevent the alloy being shaken out. (*b*) Coat the bottom of the stone with a film of real silver by precipitating it from a solution of nitrate of ammonia by means of the oils of cassia and cloves.

Colors for Jewelers' Foils.

Imitation diamonds and precious stones would not give half the lustre and sparkle they do unless backed by what are known as "jewelers' foils." These foils are colored variously so as to heighten the appearance of the stones, the colored side of the foil being placed next to the stone. The foil used by jewelers is made of copper, tin, silver, or combinations of any two of these. Some kinds of foils are made by rolling sheet metal to the requisite thickness, others by forming a solid cylinder of the metal and shaving it as the cylinder rotates. The foils are further prepared by coloring, varnishing and polishing. White foil is colored in the following manner:

Blue.

Prussian blue is rubbed up with very quick-drying oil until the desired tone is obtained. A foil of this

color is used for backing up sapphires so as to impart a deep shade to them.

Green Foil.

Dissolve shellac in alcohol and add sufficient verdigris to the solution to produce the desired tone.

Red Foil.

Dissolve carmine in ammonia or in white shellac varnish or rubbed up with isinglass. The tone in either case can be modified by mixing and the color increased after the color has been applied to the foil by lacquering it.

Yellow Foil.

Apply a solution of mastic resin and turmeric or a solution of saffron and isinglass.

Renovating Dutch Gold or Gilded Paper.

To impart a crimson hue, boil seed lac or ruby lac in a solution of soda; then let it stand at rest for some time. Pour off the clear fluid and mix with glue or isinglass and a little sugar. Apply with a brush.

Yellow Fluid for Dutch Gold and Foils.

Pour boiling water over saffron and let it stand until cold; then filter the yellow fluid and mix it with some glue or isinglass. Apply the yellow solution to the metal, and, when dry, lacquer it with a quick-drying spirit lacquer.

Green Fluid for Dutch Foil.

Reduce to very fine powder: 15 parts of ferrocyanide of iron, 15 parts of bichromate of potash, and mix these powders with 60 parts of mastic resin. Then pour on this compound sufficient wood spirit to make a clear fluid. Apply to the metal with a brush.

IVORY AND BONE.

Dyeing.

These substances can be colored with aniline dyes without any preliminary preparation, but in some cases it is necessary to soak the substance in a weak, diluted sulphuric acid to which a little tartaric acid has been added. The steeping is continued until the surface is rough and can be pressed with the fingers. Instead of the above mineral acid, boiling vinegar may be used in which to steep the ivory or bone. After this treatment, the substances are dyed by dipping them in an alcoholic solution of the dye until the color has penetrated the bone deep enough; then the material can be worked into the article for which it is intended. To restore the substance to its original hardness, wrap it in a sheet of paper covered with dry decrepitated common salt (salt that has been heated on a plate in the oven) and allow to remain for 24 hours.

Recipes for Different Colors for Ivory and Bone.

Red.

No. 1.—Steep the material in a dilute solution of aqua regia (this is made by mixing 1 part of hydrochloric acid with 2 parts of nitric acid) and then put it into a strained decoction of Brazil wood or cochineal.

No. 2.—Boil the ivory with ¾ lb. of Brazil wood and 1 gallon of water; then add ¼ lb. of alum and boil once more.

No. 3.—Dip the ivory in a weak solution of nitric acid and then steep it in the solution of carmine. By using ammonia as the solvent for the carmine, a different tone of red is obtained than when water is used.

No. 4.—Dip the ivory in a weak nitric acid and then in a solution of cochineal to which a small quantity of alum and tartaric acid has been added.

Crimson Reds.

No. 1.—Preparation of the Mordant.—Put the prepared and polished ivory in a solution of ¼ lb. of chloride of zinc and ½ pint of soft water. Allow it to remain there for 1 hour. Preparation of the Dye.—Boil for 5 minutes in a porcelain saucer 1 oz. of cochineal and 2 pinches of purified tartar in 1 pint of water. Then put the mordanted ivory in the fluid and boil until it has acquired a beautiful crimson color. If a darker tint is desired, repeat the process. Rinse the ivory with clean water, dry it, and then give a coat of bookbinders' lacquer (see lacquers in Index).

Carmine Red.

No. 1.—A carmine red is produced by rubbing 2 drachms of carmine with 6 drachms of crystallized soda, and compounding them with 1½ pints of water to the solution. Add acetic acid slightly. Boil the ivory in this bath until it has acquired the desired color.

No. 2.—The articles are first dyed in a decoction of

weld, and then in a solution of carmine. To prepare the latter, dissolve a pinch (as much as will lay on the point of a knife) of carmine in 4½ oz. of spirits of sal-ammoniac, dilute the solution with 1 pint of water and heat the fluid. Then put the articles in it and allow them to remain until they are sufficiently dyed. If the article be first mordanted by dipping in a solution of phosphate of tin instead of stannous sulphide, a more brilliant color will be acquired.

Cherry Red.

First dye the article in crimson color and then put it into a weak solution of potash until the crimson changes to a cherry red.

Orange Yellow Color.

No. 1.—Boil some rasped garlic in water for half an hour, stir the fluid, and then use the fluid as a dye bath, after first having dipped the ivory article in a solution of tin or aqua regia.

No. 2.—By adding shavings of Brazil wood to the fustic, a solution will be obtained which will produce an orange color on the bone or ivory.

No. 3.—Put the ivory into a concentrated solution of chloride of potash, and then into a boiling-hot solution of acetate of lead in water.

No. 4.—First mordant the ivory by dipping it in a solution of stannous sulphide or of alum, and then put it into a hot decoction of weld.

No. 5.—Steep the ivory in a strong solution of yel-

low orpiment (sulphide of arsenic), saturated with ammonia.

Green Color.

No. 1.—First dye the article a blue color (*vide infra*), then dip it in a solution of tin in aqua regia, and finish the dyeing in a decoction of fustic in water.

No. 2.—Dip the article in a solution of verdigris (acetate of copper). This is a very poisonous substance and should not be allowed to touch the flesh, as it will set up blood-poisoning if it gets into any cuts or cracks in the skin.

No. 3.—Put the ivory for a few hours in a partially saturated solution of chromate of potash, and then expose it to the direct rays of the sun, when it will acquire a dark bluish color.

No. 4.—First dip the article in a solution of nitric acid, then into a solution of yellow prussiate of potash (ferrocyanide of potassium), and finally dip the article into a solution of picric acid (carbolic acid crystals).

Blue Color.

No. 1.—Prepare a very dilute solution of sulphindigotic acid (this is sometimes called "indigo carmine"), which must be partially saturated with potash. By steeping the ivory in this solution for different periods of time, various tones of blue are obtained.

No. 2.—Dissolve purified indigo (blue carmine) in water, and after having mordanted the ivory by dipping it in a solution of hydrochloric acid, steep it in the indigo solution. If nitric acid be used as the mordant, the resulting tone will be a greenish blue.

Purple.

Boil the ivory in a decoction of logwood and to every pint of the decoction add 2 oz. of alum, and boil the articles in the fluid.

Violet.

No. 1.—Mordant the ivory by dipping it in a solution of tin (as given under carmine), and then put it into a decoction of logwood in water.

No. 2.—Dye the ivory red and then dip for a minute in a solution of indigo.

Lilac.

Lilac is produced by putting the mordanted ivory in a nearly exhausted bath of logwood.

Black.

No. 1.—Steep the ivory for some time in a dilute solution of nitrate of silver and then expose it to the sun. Repeat this operation several times so as to produce a deep black color.

No. 2.—Boil the ivory in a strained decoction of rasped logwood. Then take it out and put it into a solution of sulphate of acetate of iron or else one of bichromate of potash.

No. 3.—Boil the article first in a decoction of gallnuts and logwood and then in a solution of sulphate of acetate of iron. If, as in billiard balls, white stripes are desired on a black ground, saturate a piece of ribbon with wax, lay it around the ball and bind some twine round to keep the ribbon in its place. Where the rib-

bon touches, the ivory will be left uncolored. It should be noted that all colors adhere better to unpolished than to polished ivory, and it is therefore better to polish the articles after they have been dyed. The polishing is done by rubbing some soap and Vienna lime over the ivory with the palm of the hand. When dyeing by boiling, the boiling should not be long continued or else the ivory will become full of cracks; and it should also be cooled off quickly by being placed in cold water when taken out of the hot dye liquor. Instructions for dyeing ivory and bone with aniline colors are given in another section.

To Decorate Ivory With Black or Colored Etchings or Drawings.

Melt together 1 oz. of mastic in tears, 1 oz. of wax and 9 drachms of powdered asphaltum. Mix well by stirring. Put the compound into tepid water to cool. Then roll it into balls of about 1 inch diameter. Instead of the above a compound arranged as follows can be used: $2\frac{1}{4}$ oz. of asphaltum, 1 oz. of rosin and 9 drachms of white wax. To decorate the ivory, first warm the surface and then rub the wax compound all over it. Then etch in the drawing with an etching needle so as to scratch the surface of the ivory. Put the ivory into concentrated sulphuric acid, which will attack the ivory where it is exposed by the etching needle and blacken it. Afterwards remove the wax by warming the ivory and rubbing off the wax with a cloth. Nitrate of silver will also produce a black, while chloride of gold will produce a purple coloration. Any of the

other colors already mentioned can be used. As the rubbing off of the wax might spoil the etching, the wax is best removed by steeping the ivory in oil of turpentine.

To Make Ivory Soft and Flexible.

Put some phosphoric acid of 1.130 specific gravity into a wide-mouthed bottle and soak the ivory articles in this acid until they assume a transparent appearance. Then take them out of the acid, wash them carefully in water and dry them between soft cloths. The ivory will be found as soft as leather, but becomes hard again on exposure to the air. It can be made to assume its plastic condition by steeping in warm water. A weaker acid than the above will have no effect on the ivory.

To Bleach Ivory Articles Fastened Upon Leather, Etc.

Mix some hydrochloric acid with a solution of chloride of lime; this mixture will generate chlorine gas, which is a powerful bleaching agent. Apply the mixture to the ivory with a brush and then expose the ivory to the sun's rays. To prevent the leather being attacked by the bleaching agent, it is best to cut out a piece of paper to the shape or pattern of the ivory ornament and lay this over the leather. If necessary, fill up the joint with wax. When the article is bleached, wash off the particles of lime with a brush and soft water. Polish with precipitated chalk. Several applications of the above mixture must be made when bleaching horn. The acid used should be of concentrated strength, but a paste may be made (without acid), consisting of 1 part of water and 1 part of chloride of lime.

To Silver Ivory.

Take a small piece of nitrate of silver and pound it in a mortar. Add some soft water to it, mix thoroughly and put in a bottle. Place the ivory article to be silvered in this solution and allow it to remain until it is of a deep-yellow color. Put it then in clean water and place it in the sun. If desired to draw any figure or name upon the ivory, it may be done with a camel's-hair pencil dipped in the solution. Wash well with water after the drawing has become a deep yellow and put it in the sunlight, occasionally wetting with soft water. Rub it after it has turned a deep-black color and it will change to a brilliant silver.

Make a weak solution of nitrate of silver, immerse the ivory in it and allow it to remain until the solution gives a deep-yellow color. Immerse it in clean water and expose it in the water to the sun. It becomes black in about three hours. The black surface becomes a brilliant silver by rubbing.

THE DECORATION OF IRON, STEEL, ETC.

Enamels and Vitreous Glazes.

To enamel cast-iron articles, four compounds are employed, one for the ground and the others for the surface or glazing. To prepare the ground for the enamel, mix together and fuse in clay crucibles, 110 parts of quartz, 50 parts of borax and 16½ parts of fluorspar. Take 35 lbs. of this mass and mix it with 14 to 27½ lbs. of quartz, 9 to 14 lbs. of gray clay and 1 lb. of borax. Grind this mixture, and while grinding, add 5½ lbs. of clay and ½ lb. of borax. Then make the compound into a paste with water, and lay a coating of it on the vessel and burn it in. For the glaze or surface coat, mix together the following ingredients:

5½ lbs. of fluorspar,
2¼ lbs. of zinc oxide,
10½ lbs. of stannous oxide,
1¼ lbs. of bone meal in fine powder,
1 to 1½ oz. of whiting.

To this add:

34½ lbs. of fluorspar,
20 to 21½ lbs. of borax,
7 lbs. of carbonate of soda,
2¼ to 3½ lbs. of nitrate of potash.

Fuse the mixture in a refractory clay crucible with a hole in the bottom through which the liquid mass escapes into a vessel placed beneath the furnace. The mass when cooled is pulverized and ground and 4 oz. of washed white clay and ½ lb. of zinc oxide is added during the process of grinding to every 66 lbs. of the mass. The compound is then applied to the vessel in the usual manner and burnt in.

Tinning Cast Iron.

No. 1.—Dissolve 1 oz. of chloride of tin in 10 oz. of water, separately dissolve 2 oz. of caustic soda in 1 pint of water and mix the two solutions. Heat the articles to be tinned and then dip them in the above fluid. The liquid should be frequently stirred and a few granules of tin kept in the bath.

No. 2.—Boil 3 oz. of rice flour in 5 pints of water for thirty minutes, and strain. Then mix with the resulting thick fluid, 106 oz. of phosphate of soda, 17 oz. of crystallized stannous chloride, 67 oz. of solution of stannous chloride and 25 oz. of sulphuric acid. The articles should be cleaned, dipped in the above mixture and allowed to remain for a few minutes, then taken out and dried.

No. 3.—Make a compound of 8 oz. of solution of stannous chloride, 16 oz. of tartar and 2 oz. of stannous chloride. Connect the articles by a wire with the positive pole of a Bunsen's battery, while the magnetic pole communicates with a piece of tin that dips into the above mixture.

Cold Tinning.*

Remove all grease from the articles by washing them in boiling potash solution and then pickle in an acid bath composed of 20 parts of sulphuric acid per 100 parts of water. Afterwards carefully scour the articles with sand and then dip them in the tinning solution, which is prepared by mixing 7 to 10½ oz. of tin salt, 10½ oz. of alum, 7 oz. of tartar, and 22 gallons of water. A strip of tin is wrapped around the different articles before dipping them in this bath, where they remain for 8 to 10 hours longer, according to the thickness of the coating they are to receive. The articles are removed from this bath, rinsed off and put into water in which ¼ to ½ oz. of carbonate of magnesia per quart has been dissolved.

Galvanizing Iron.

First cleanse the article by washing in dilute acid, rinse off the acid and put into a solution of zinc chloride, and connect with the positive pole of a dynamo machine. Zinc plates connected with the positive pole of a dynamo machine are suspended in the fluid and the machine set to work. The coating of zinc thus produced

*Mr. John F. Brady of Providence, R. I., thinks this cleansing operation can hardly be improved upon. He also suggests the following formula as the best he has found for this class of work: Pyrophosphate of soda, 80 parts; caustic soda, 10 parts; protochloride of tin, 10 parts, and distilled water, 5,000 parts. Dissolve the pyrophosphate of soda and caustic soda in the water and stir in the tin salt which has previously been dissolved in water. This solution should be used with a large tin anode and a current of from four to six volts.

is provided with a metallic lustre by quickly warming the articles over a fire or placing them in a chamber or oven sufficiently hot to melt the zinc. If at the same instant that this takes place a shock or shake is given to the article, the coating will assume the spangled appearance so much sought after.

Mixture for Galvanizing Copper, Bronze, Etc.

Dissolve in 5 parts of soft water, 4 oz. of yellow prussiate of potash, 2 oz. of subsulphide of copper and 2 oz. of carbonate of potash. For bronzing add 25 oz. of sulphate of zinc to the above coppering fluid and filter the solution. The bath for bronzing wrought and cast iron consists of 1,000 oz. of soft water, 58 oz. of yellow prussiate of potash, 15 oz. of chloride of copper, 40 oz. of tin salts and 40 oz. of sodium hyposulphite. Pour the above fluid into a cast-iron boiler, and heat over a moderate fire, the metal to be coated with copper, brass, or bronze, being connected with the cathode of the galvanic battery and submerged in the bath, using as an anode a piece of the metal that is to be deposited. The metal to be coated must be first thoroughly cleansed and polished.

To Give Cast-iron and Steel Articles a Coating of Copper.

Melt in a crucible 1 oz. of dry chloride of copper and 5 or 6 of cryolite combined with chloride of barium to make it more fusible. This mixture will give a permanent coating of any desired thickness to the article, according to the duration of the immersion.

To Tin or Copper Gray Iron Castings.

Cleanse the castings by pickling in dilute sulphuric acid (1 to 20 of water) and scouring with water if necessary. Then boil them in concentrated aqueous solution of stannate of soda with a quantity of granulated tin. To copper castings: Clean the iron as above, and tumble for a few minutes in sawdust moistened with a solution of copper in 2 gallons of water made slightly acid with sulphuric acid. Wash immediately in hot water.

To tin small castings: Clean and boil them with scraps of block tin in a solution of cream of tartar.

To Tin Iron Cold.

Take equal parts of quicksilver and block tin and melt them together. Mix also equal parts of muriatic acid and amalgam. Apply the amalgam with a clean rag steeped in the mixture.

To Tin Tacks.

A process of tinning iron tacks is to triturate chloride of zinc with a large quantity of oil and heat it in an oscillating vessel. As soon as this has reached the proper temperature, throw in the tacks and after a few minutes dip them out in wire basket and cast into water.

To Give Tin a Crystalline Appearance (Moire Metallique).

This process is much used for tinplate, trunks and fancy articles. It is usually prepared from well an-

nealed and well tinned charcoal iron plates by rinsing the plates with nitro-hydrochloric acid and then with water. The cleansed plates are then dipped for a few moments in aqua regia (1 part of nitric and 3 parts of hydrochloric acid) diluted with 1 to 3 volumes of water and heated to about 180° F. and after a short exposure rinsed in running water and dried in the air, then oiled or lacquered.

The following is the most approved method of producing Moire Metallique: The iron plate to be tinned is dipped into a tin bath composed of 200 parts of pure tin, 3 parts of copper and 1 part of arsenic. When thus tinned, the sheet iron is submitted to the seven following operations:

(*a*) Immersion in lye of caustic potash and washing.

(*b*) Immersing in diluted aqua regia and washing.

(*c*) Immersion in lye of caustic potash and washing.

(*d*) Quickly passing through nitric acid and washing.

(*e*) Immersion in a lye of caustic potash and washing.

(*f*) Immersion in aqua regia and washing.

(*g*) Immersion in a lye of caustic potash and washing.

The coat of oxide must be entirely removed at each washing and the last washing should be in hot water.

Process of Tin Plating.

The Contact Process.—In tinning hollow ware on the inside, the metal is first thoroughly cleansed by pickling it in dilute sulphuric acid and scouring it with sand. It is then heated over a fire to about the melting

point of tin, sprinkled with powdered resin and partly filled with pure grain tin covered with resin to prevent its oxidation. The vessel is then quickly turned and rolled about in every direction so as to bring every part of the surface in contact with the molten metal.

The greater part of the tin is then thrown out and the surface rubbed over with a brush to equalize the coating. The brush is made of tow. The vessels must be hot enough to keep the tin contained in them fused.

The Amalgam Process.—This is not so much employed as it used to be. It is carried out by applying to the clean and dry metallic surface a film of a pasty amalgam of tin with mercury and then exposing the surface to heat which volatilizes the latter, leaving the tin adhering to the metal.

The Immersion Process.—This is best adapted to coating articles of brass or copper. When immersed in a hot solution of tin properly prepared, the metal is precipitated upon the surfaces. One of the best solutions for this purpose is the following:

17½ oz. of alum,
12½ oz. of boiling water,
1 oz. of protochloride of tin.

The articles to be tinned are first thoroughly cleansed, then put into the hot solution until properly whitened.

A better coating can be obtained by using the following bath and placing the pieces in contact with a strip of clean zinc also immersed in it:

14 oz. of nitrate of potassium,
24 oz. of soft water,
1 oz. of protochloride of tin.

It should be boiled for a few minutes before using.

The following is one of the best solutions for plating with tin by the battery process:

12 oz. of potassium pyrophosphate,
4½ oz. of protochloride of tin,
20 oz. of water.

The anode or feeding plate used in this bath consists of pure Banca tin. This plate is joined to the positive plate of the battery while the work is suspended from a wire connected with the negative (zinc) pole.

In Weigler's process a bath is prepared by passing washed chlorine into a concentrated solution of stannous chloride to saturation and expelling the excess of gas by warming the solution, which is then diluted with about 10 volumes of water and filtered if necessary. The articles to be plated are pickled in dilute sulphuric acid, and polished with fine sand and scratch-brushed, rinsed in water, loosely armed with zinc wire or tape and immersed in the bath for ten minutes at ordinary temperature. The coating is finished with the scratch-brush and whiting. By this process, cast or wrought iron, copper, steel and lead can be tinned without a separate battery. The only disadvantage of the process is that the bath is soon clogged up with the zinc chloride, and the tin salt must be frequently renewed.

In Hern's process a bath composed of

2 oz. of tartaric acid,
100 oz. of water,
3 oz. of soda,
3 oz. of protochloride of tin,

is employed instead of the above. It requires a some-

what longer exposure to properly tin articles in this than in Weigler's process. Either of these baths may be used with a separate battery.

Tinning Iron Articles by Simple Immersion.

A solution is first made by dissolving with the aid of heat in an enameled pan, 2½ grams of protochloride of tin (fused), 75 grams of ammonia alum, 5 litres of water. The chloride of tin is readily made by dissolving grain tin in hydrochloric acid with the aid of heat, care being taken to have an excess of metal in the dissolving flask. When the bubbles of hydrochloric acid which have evolved, cease to be given off, the action is complete. If the solution be evaporated at a gentle heat until a pellicle forms on top and the vessel then set aside to cool, needle-like crystals are obtained, which may be separated from the mother liquor by tilting the evaporating dish over a second vessel of the same kind. When all the liquor has thoroughly drained, it should in its turn be again evaporated, when a fresh crop of crystals will be obtained. The crystals should, before washing, be gently dried over a sand bath. When the solution of tin and alum has been brought to a boil, the iron articles, after being well cleansed and rinsed in water are to be immersed in the liquid; they quickly become coated with a delicately white film of a dead or matted appearance, which may be rendered bright by means of bran in a revolving cask or in a leathern bag shaken by two persons, each holding one end of the bag. To keep up the strength of the tinning bath,

small quantities of the fused chloride of tin are added from time to time.

To Re-Tin Copper.

No. 1.—Make the copper chemically clean by washing with a saturated solution of zinc in hydrochloric acid, the acid being diluted with water to half strength after dissolving the zinc. Heat the copper vessel and pour in a small quantity of metal, tin 1 part and lead 1 part, and shake or tip the vessel until the tinning runs over the parts. Or wipe the melted tin over the bare parts with a cotton canvas pad.

No. 2.—The best way to tin old copper utensils is to thoroughly clean them with sand and oxalic acid and tin with a large copper-soldering iron, using chloride of zinc and salammoniac soldering fluid for flowing the tin. It can also be done by heating the vessel and flushing melted tin over the surface, first sprinkling it with powdered resin.

ENAMELS AND GLAZES.

Colored Enamels for Metals.

The ingredients are powdered to an impalpable state in a stone mortar and then placed in a heated crucible. To secure the crucible in the furnace, a piece of brick is laid on the grate. The firing is done either with charcoal alone or with charcoal mixed with coke.

To prepare the fluxes, a suitable furnace is used which must be free from rust and lined up to the cover with fire bricks set in clay so that only the opening for the door remains free. Through a hole in the centre of the cover, which is also provided with a cover, the ingredients in the crucible are stirred with an iron rod.

Preparation of Fluxes.

No. 1.—Fuse:

8 parts of minium,
1½ parts of borax,
2 parts of ground flint,
6 parts of flint glass.

No. 2.—Fuse:

10 parts of flint glass,
1 part of white arsenic,
1 part of nitrate of potash.

No. 3.—Fuse:

1 part of minium,
3 parts of flint glass.

No. 4.—Fuse:

10 parts of minium,
5½ parts of borax,
8½ parts of flint glass.

No. 5.—Fuse:

6 parts of flint glass,
7 parts of the flux prepared according to No. 2, with 8 parts of minium.

No. 6.—Fuse:

6 parts of the flux prepared according to No. 4, and 2 parts of powdered flint.

Fluxes prepared as above are cooled off in water, then dried, and finally reduced to powder in a stone mortar.

Blue Enamel.

No. 1.—Powder and mix:

4 parts of black oxide of cobalt,
9 parts of flint,
13 parts of nitrate of potash.

Fuse these thoroughly over a charcoal or coke fire. Pulverize them, wash in cold water and triturate 1 part of this powder with 1 part of flux No. 5.

No. 2.—Fuse together:

1 part of black oxide of cobalt,
1 part of borax.

Mix these by melting over a good fire 2 parts of this to 10 parts of blue pot glass and ½ part of minium.

Black Enamel.

No. 1.—Triturate with water:

1 part of black calcined umber,
1½ parts of black oxide of cobalt,
1½ parts of black oxide of copper,
3 parts of flux No. 4.

Allow it to dry thoroughly, and then heat it in a fire upon a brick with pulverized flint, and add 1 part of flux No. 3.

No. 2.—Mix and triturate with sufficient water, 1 part of black oxide of copper and 2 parts of flux No. 4.

No. 3.—Black enamel for painting and mixing with other colors to produce shades.—Heat small pieces of umber in a crucible until they becomme black, and then wash in boiling water and dry. Fuse together 10 parts of this prepared umber, 10 parts of black oxide of cobalt, 10½ parts of blue flint glass, 7½ parts of borax and 12 parts of minium. For use, triturate 2 parts of this mixture with 1 part of flux No. 4.

Brown Enamel.

Fuse together 2½ parts of pyrosulphite (black oxide of manganese), 8½ oz. of minium and 4 oz. of pulverized flint. Take 1½ parts of the mixture and triturate it with 1 part of the flux No. 4 and 1½ oz. of iron filings.

Reddish Brown Enamel.

Triturate in water 1 part of brown sulphate of iron and 3 oz. of flux No. 1.

Vandyke Brown Enamel.

Fuse together in a crucible 3 parts of flux No. 4 and 1 part of iron filings. Lift it out by the tongs. Take 5 parts of this and 1 of black oxide of cobalt and make into a paste with water.

Green Enamel.

Mix and heat without fusing 12 parts of minium, 1 part of sulphate of iron, 4 parts of antimony oxide and 3 parts of pulverized flint. Triturate with water and 1 part of iron and 2½ parts of flux No. 7.

Yellow Enamel.

Mix in a stone mortar 8 parts of minium, 1 part of antimony oxide and 1 part of white oxide of tin. Put the mixture in a crucible and raise it to a red heat. Then cool off and rub 1 part of this and 4½ parts of flux No. 4 to a paste with water.

Orange Enamel.

Mix and heat without fusing 12 parts of minium, 1 part of red sulphate of iron, 4 parts of antimony oxide and 3 parts of pulverized flint. Triturate with water 1 part of this to 1½ parts of flux No. 7.

To Enamel Cast Iron.

No. 1.—Reduce to powder and mix:

3½ oz. of crystal glass,
1 oz. of purified potash,
1 oz. of nitrate of potash,
½ oz. of borax,
3¼ oz. of minium (red lead).

Heat the ingredients in a clean, covered crucible, whereby a shiny appearance will at first take place and the mass will finally fuse to clear liquid glass. This is poured upon an iron plate, previously moistened, cooled off with water and rubbed to a thin paste upon a glass plate. Pour this paste on the article to be enameled, allow it to dry very slowly and then put the article in a hot muffle furnace. The enamel will in a few minutes fuse uniformly without bubbles and form a lustrous, transparent surface. To impart a blue tint to the enamel, mix with the above $1\frac{1}{2}$ drachms of a precipitate of cobalt, obtained by saturating nitric acid with cobalt, decomposing this with common salt and evaporating the mixture to dryness. This gives the blue color to the enamel.

No. 2.—Keep the article to a red heat in sand for $\frac{1}{2}$ hour, cool off slowly and cleanse with hot diluted sulphuric acid. Rinse with water and dry. Coat the material with a mixture composed of:

6 oz. of flint glass,
3 oz. of borax,
1 oz. of minium,
1 oz. of zinc oxide.

Reduce all to fine powder and roast it for 4 hours at a red heat. Increase the temperature until the mixture becomes semifluid, then cool by pouring into cold water and mix 1 pint of it with 2 parts of bone meal and make into a paste with water. When the coating on the article is dry, apply a mixture of:

32 oz. of calcined bones,
16 oz. of kaolin,
14 oz. of feldspar,
4 oz. of potash.

Mix with water, dry, cool, and when powdered, make into a paste with sufficient water. When the second coat is dry, apply a mixture of:

4 oz. of feldspar,
4 oz. of pure sand,
4 oz. of potash,
6 oz. of borax,
1 oz. of oxide of zinc,
1 oz. of nitrate of potash,
1 oz. of white arsenic,
1 oz. of pure chalk.

Mix, calcine, cool off and then reduce to a fine powder with $3\frac{1}{2}$ parts of calcined bones and 3 oz. of quartz. The coated articles are heated in a muffle in a furnace, which fuses the last two coatings and forms an adherent and brilliant white enamel.

Glaze for Enamelling Cast Iron.

Mix together:

4 parts of powdered glass,
2 parts of fluorspar,
1 part of nitrate of potash,
1 part of zinc oxide.

Fuse them in a crucible and pour out into molds to cool. For use, the necessary quantity is rubbed up with water. Heat the iron article to a red heat in a muffle

furnace, and apply the enamel, which will present a brilliant glaze appearance. To render the enamel of a blue color, add cobalt oxide. For red, use minium; for black, nigrosine; for yellow, use uranium oxide; for brown, ferric oxide; for green, a mixture of 2 parts of stannous oxide and 1 of manganese oxide; for pure white, use stannous oxide.

Enamel for Sheet-Iron Articles.

Cleanse the vessel by pickling in diluted sulphuric acid, rinse off with water and scour with good sand. Then apply a solution of gum arabic in water, dust upon the article while still moist the above powder, and dry at 212° F. When the vessel is dry, remove the excess of powder gently with the hand and observe whether there are any places which have not been dusted. Should this be the case, they must be again dusted in the same manner. The enamel is prepared as follows:

65 oz. of crystal glass,
10 oz. of calcined soda,
6 oz. of boracic acid.

Grind and mix together several times. This powder, after being liquefied on the sheet iron and placed in a red-hot muffle, forms the ground for the actual enamel, which is not quite so refractory. This consists of:

66 oz. of crystal glass,
10 oz. of calcined sand,
2 oz. of boracic acid,
4 oz. of litharge.

To Enamel Copper Cooking Vessels.

Reduce to powder and mix:

12 oz. of white fluorspar,
12 oz. of unburned gypsum,
1 oz. of borax.

Fuse the mixture in a crucible. Apply a coating of this with a brush to the inside of the vessel and place this in a moderately warm place so that the paste will dry uniformly. When dry, heat the vessel to such a degree in a muffle that the paste which has been laid on liquefies. When cold, the paste will be a white opaque enamel.

Renovating Metals by Niello.

This metallic enamel is composed of:

4 parts of pure silver,
9 parts of pure copper,
9 parts of pure lead,
2 parts of borax,
48 parts of flowers of sulphur.

The method of incorporating these ingredients is to first melt the silver in a crucible, then add the copper, and when both are liquid, add the lead and stir the molten alloys with a stick of charcoal to ensure homogeneity. Pour the mixture into a large crucible containing the sulphur and keep the crucible on the fire until the mass is a liquid. Then pour it out into water so as to granulate the alloy. The best way to ensure granulation is to put a bundle of brushwood in the water and pour the alloy over it so that the alloy is dispersed and granules formed. These granules are col-

lected, dried by exposure to the air and then pulverized in a mortar. This powder is mixed with spirits of sal-ammoniac to a paste. For use, the metal to be decorated is etched or engraved with the design to be represented, and the metal article heated; then the paste alloy is rubbed into the etched lines. When the metal has cooled, the excess of melted paste is removed by filing. The surface is then stoved and polished.

Black Enamel for Bicycles.

Melt 40 oz. of asphaltum in an iron vessel by slow heat, then add ½ gallon of boiled linseed oil, 6 oz. of litharge, 4 oz. of powdered sulphate of zinc and 6 oz. of red lead. Boil all together for two hours, then stir in 8 oz. of fused dark amber gum and 1 pint of hot linseed oil. Boil for two more hours. When the mass has thickened, remove it from the fire and thin down with 1 gallon of turpentine.

GLASS SIGNS, ETC.

Engraving on Glass.

Grind the surface of the glass until it is opaque, and draw the design upon it with a mixture of anhydrous boracic acid, gum and water. When the drawing is dry, heat the glass sufficiently to melt the boracic acid. The acid gives the gum its original transparency and the design is fixed. Colored designs are produced by adding different metallic oxides to the boracic acid.

Colored Designs Upon Glass.

Coat the glass with shellac varnish or oil of turpentine. Cover with the pattern and dust the pulverized color over the cut-out places in the pattern. When dry, place the glass in a closed muffle to burn in the color.

Engraving Glass With Acids.

Coat the glass with wax and engrave the design so that it shows through. Pour 2 parts of sulphuric acid over 1 pint of pulverized fluorspar in a leaden vessel and place it on the prepared glass, drawing-side downwards. The design will be etched upon the glass in about an hour or two. The mixture is removed with oil of turpentine. The hydrofluoric acid that is produced by the mixture of the acid and fluorspar cannot be kept in vessels except they be of lead or guttapercha, as the acid

is very corrosive and should not be allowed to touch the flesh, nor should the vapor that arises be inhaled. A simpler process is to apply an aqueous solution of hydrofluoric acid to the design with a soft brush. By repeating the operation several times the design or pattern will be found engraved on the glass. But the etching done with this aqueous solution is much inferior in sharpness and opacity to that done by the vapor.

No. 1.—To Etch Glass (Fine-Ground).

Paint the entire glass except the parts to be etched with ordinary iron lacquer which covers well. Allow it to dry, but not entirely hard, as otherwise the acid is apt to find its way under the iron lacquer. Place a layer of putty, prepared with wax and starch, around the design, care being taken that it laps over upon the iron lacquer. Then pass hydrofluoric acid upon the surface, let it stand for 5 minutes, pour it back into the flask and wash the entire surface with water. Then remove the asphaltum with oil of turpentine and again wash the article with soap and water.

No. 2.—To Etch Glass (Coarse-Ground).

Proceed in the same manner as above, but throw some emery into the acid immediately after it has been poured upon the surface. Let it remain for 5 minutes; then put it back into the flask and wash and cleanse as above.

To Gild Glass.

Polish the glass thoroughly with whiting and then with a linen rag dipped in alcohol. Prepare a size by

boiling 2 oz. of isinglass in sufficient water to cover it, and when dissolved add 1 quart of alcohol. Then dilute in 2 parts with water and filter. Flood the surface to be gilded with the size, laying the gold leaf flat on it, and scatter electricated chalk, previously washed, over the whole. Should the chalk form lumps in handling, rub it fine; but the dusting over with chalk must be delayed until the gold leaf is dry. When the gold leaf is entirely dry, dust it off with a fine brush and then polish with a piece of silk. Repeat the gilding once more and then back all the gold which is to remain with copal or dammar varnish. When this is dry, remove the superfluous gold by rubbing with the moistened fingers.

Silvering Glass.

This is done in the same manner as gilding (above described), but somewhat more isinglass is used, as the silver leaf, being softer than gold leaf, requires a stronger agglutinant.

Gilding on Show-Windows.

The same solution of isinglass as used for gilding glass is employed. Cover the surface to be gilded with the mixture and lay on the gold leaf. When dry, polish the gold with a rag of silk velvet and repeat the operation. If, after the second polishing, stains should make their appearance on the gold, the solution contains too much isinglass and must be diluted by adding distilled water and rectified alcohol. But if the gold cannot be polished, the mixture contains too little isinglass. It is therefore advisable to first test the solution upon a sheet of glass.

To Back the Inscription on Show-Windows.

Proceed as follows: After rubbing off the superfluous gold with the finger, apply to the entire superscription a coat of gold oil paint mixed with some hemp oil and English carriage varnish, which will preserve the inscription even upon panes covered with moisture.

To Back Glass Signs with Tin Foil.

This is done in the same manner as mother-o'-pearl, except that the oil paint is not allowed to dry entirely but to remain sticky—tacky—enough to fasten the tinfoil by a gentle pressure, care being taken to place the glossy side of the tinfoil upon the glass.

Transparent Glass Designs.

Coat a glass with paint so that the places to be transparent remain free. Back this glass plate with a second, and fill the space with pieces of colored glass of irregular sizes. By illuminating the sign from the back a pretty effect is obtained. Instead of colored glass, sheets of colored tinfoil, slightly crumpled up, can be placed between the sheets of glass to represent the inscription.

To Back Glass Signs Without Shades.

After carefully rubbing off the superfluous gold with the fingers, apply two coats of transparent black rubbed up in oil to the entire back of the glass and inscription.

To Back Glass Signs with Shades.

Apply two coats of the same black, but leave the shades free. When the black is dry, paint the places to represent the shade with red, green, blue, etc., oil paint.

Decorating Glass Show-Cases With Mother-o'-Pearl Inscriptions.

Gild in the manner described above. When the gold is dry, coat only the outline of the inscription with copal or dammar lacquer. After carefully removing the superfluous gold, apply two coats of the above-mentioned black oil paint, leaving free the inner part of the inscription for the mother-o'-pearl. If the inscription is to be shaded, proceed in the same manner as described for backing glass signs with shades. To insert mother-o'-pearl inscriptions, use very thin laminæ of the pearl of different colors. Select suitable pieces, and if too large, break them in two; then coat first the places left free in the inscription with dammar lacquer, and then one side of each of the pieces of mother-o'-pearl. Lay them on the inscription and press down gently with the handle of the brush, continuing this until the entire surface is covered. Do not place the pieces close together, but leave small spaces between them, which are afterwards filled up with lacquer and pulverized oyster shells or other shells dusted on.

Etching Fluid for Glass.

Put into a wedgeware mortar equal parts of hydrofluoric acid, fluoride of ammonium and dry precipitated barium sulphate and rub them up together. When in-

timately mixed, transfer the mass to a dish made of platinum, lead or guttapercha, and pour fuming sulphuric acid over it successively and rapidly, stirring with a guttapercha rod shaped like a pestle until the impression left by the rod quickly disappears. The resulting fluid can be applied with an ordinary steel pen and the glass written on is etched immediately, the etched portions being so well roughened that they are visible at a distance. The fluid only needs to act for 15 seconds on the glass, as a longer action may cause the edges to lose their sharpness.

The etching fluid cannot be kept in glass bottles but only in guttapercha vessels closed with corks that are protected with wax or paraffin. Owing to its greater specific gravity, the barium compound used to thicken it settles, hence the bottle must be well shaken each time before using. To make a good quality of etching fluid, the quality of the barium sulphate is of great consequence. It is best prepared by precipitating barium chloride with an excess of sulphuric acid, washing well by decantation, filtering and drying at 248° F. It is only in this manner that it can be obtained sufficiently fine and impalpable. Concentrated hydrofluoric acid may cause serious ulcers or inflammation of the skin if it comes in contact therewith for some time, so that care should be taken in making and using the fluid not to touch it with the fingers.

To make ordinary etchings more distinct and visible at a greater distance, it is frequently necessary with delicate lines, especially on graduated chemical ware, burettes, eudiometers, etc., to rub some clay, red lead

or soot over them. A small quantity adheres to the roughened surface, but it soon comes off. The etchings made with this fluid are so rough that if a strip of metal is rubbed over the lines some will adhere and acquire the color and lustre of the metal. If a name is written on glass with the fluid and the spot rubbed with a thick brass wire, the name will appear in golden letters and may be protected with a thin coat of varnish. Lead may also be used, but for chemical apparatus, platinum is preferred, as it easily rubs into the lines and requires no protective coating.

Ornamenting Frosted Glass.

A method of ornamenting frosted glass for those who cannot draw is to choose some pretty pattern of lace, say from a window-curtain. Lay it smoothly on thin paper and with a pencil trace the outlines. Then, after making as many layers as you require patterns, cut out the designs at one operation through the several layers of paper with a pair of sharp-pointed scissors. Fasten the patterns with tacks to the frame around each piece of frosted glass you wish to decorate. Tie up a piece of putty in a piece of thin muslin, leaving enough of the latter to hold as a handle. With this dabble all over that part of the glass which the pattern leaves bare. When the putty on the glass has dried, remove the paper and varnish the glass, using a colored varnish if desired.

To Decorate Glass With Photographs.

Separate the paper print from the background by steaming it, dry thoroughly, and having given the

warmed glass an even coating of balsam or negative varnish, place the face of the print on the surface thus prepared. Smooth it out and let it stand in a cool place until the varnish has hardened. Then apply water, and with a piece of soft india-rubber rub off the paper so as to leave the photographic image on the varnished glass.

Platinizing Glass.

In order to succeed in coating porcelain or glass with a faultless film of platinum of the brilliancy of silver it is indispensable to make use of a perfectly dry chloride of platinum, as free from acid as possible. For that purpose pour some oil of rosemary over the dry chloride of platinum in a small porcelain mortar and knead it up with the pestle, renewing the oil about three times. Continue this operation until there is produced from the brownish-red chloride a black plastic mass, wherein no particles of undecomposed chloride of platinum can be found. The oil of rosemary assumes thereby a more or less yellow color in consequence of partially taking up chlorine from the chloride of platinum.

When the whole of the chloride of platinum is thus reduced, and after pouring the oil of rosemary off, rub it up well with the pestle with about five times its weight of oil of lavender, until it has become a perfectly homogeneous thin fluid. Then, after leaving it to stand for half an hour or so, apply the mass as uniformly as may be and in the thinnest possible layer to the object of porcelain, earthenware or glass by means of a soft and delicate brush. The thinner the coat of the application, the more brilliant the film of platinum. All that

is required further is to subject the article for a few minutes to a very low, scarcely perceptible, red heat, either in a muffle or in the flame of a Bunsen's gas blowpipe used with caution. The article receives from this baking a beautiful lustre as brilliant as silver. If by an oversight the coating of platinum upon the article has turned out faulty, or if breakages occur during the baking, every trace of the metal can be recovered from the objects. Nothing more is required than to pour common hydrochloric acid over them and then touch them with a zinc rod. In consequence of the hydrogen evolved, both at the upper and lower surfaces of the film of platinum which acts as the negative pole, the shining metallic coating instantly peels off in the form of extremely thin leaves from the base of the porcelain or glass, and notwithstanding the specific gravity of the metal, these ascend partially and float on the surface of the acid. On separating the hydrochloric acid by the use of a filter, the whole of the platinum is recovered. Only as much of the platinizing fluid should be prepared at once as is required for immediate use, as it loses its efficiency by keeping.

GILDING AND SILVERING.

Gilding on Wood.

Gilding on wood, called "oil gold," cannot be burnished and is always of the natural color of unwrought gold. It has the advantage that it can be washed and cleansed with water, which burnished gold will not stand. It is often used for parts of furniture and mouldings of rooms, and as it stands the weather, it is also employed for outside work.

The *modus operandi* is as follows: The surface to be gilded must first be rubbed smooth with shave grass. After this, apply a priming of glue size and two coats of oil paint and one of flatting. To enrich the color of the gold these last may be laid down in red or yellow. White, however, is usually preferred, as the darker color renders any imperfection in the gold sizing more difficult to detect. When the last coat of paint is thoroughly dry, rub it over with wash-leather to render it smooth and free from dust and grit. If any patterns are to be left ungilded, they should be pounced over with white to prevent the gold leaf adhering to them. Another way is to paint them over with white of egg diluted with water. If any gold sticks to this it can be easily washed or wiped off with a moistened linen cloth. When all is

ready for sizing, strain sufficient size through muslin and put some out on the palette, adding to it enough ochre or vermillion mixed with oil alone to color. Then, with a stiff hog's-hair tool, commence painting it on the surface, taking care to lay it on smoothly and not too thick, as in the latter case it runs and leaves wrinkles in the gilding. Size always from left to right, beginning on the top of the surface and working downwards. Move the brush lightly and firmly, mapping out the surface to be sized into several squares, and finishing and cross-hatching each before proceeding onwards. If there are patterns to be left ungilded, carefully trace around their outline with a sable pencil and then fill in the interstices. When the whole surface is covered with size give it a thorough inspection to make sure there is no faulty portion, but if there is, delicately touch in the size with a small pencil. When perfect gilding is required, it should be sized twice, the first coat being allowed to dry before the second is applied. In carved work, be careful to dip the brush down into the hollows of the carving. It is a good plan to size over night so as to gild in the morning. But all size does not dry alike, sometimes taking 12 or 24 hours before it is ready for the gold leaf in damp weather, or in humid locations always more than in dry. The readiness of the size can only be ascertained by the touch. If on being touched by the finger the surface daubs or comes off, it is not ready; but if it feels clammy and sticky it is sufficiently dry. If too dry, it must be sized again. The books of gold leaf should always be placed before a fire half an hour previous to use in order to dry the

gold and make it more manageable. When all is ready, shake out several leaves on the cushion and blow them towards the parchment screen. Then carefully raise one leaf with the knife and place it on the cushion, gently blowing or rather breathing on it to flatten it out. If it curls up, work it about with the knife until it lies flat. Then replace the knife in its loop under the cushion, and taking the tip, pass it lightly over your hair or whiskers, thus acquiring sufficient greasiness, or electricity (?), to enable the gold to stick to it. Lay the hair portion of the tip carefully upon the gold leaf and then raising it apply to the sized surface. As in sizing, work from left to right and be especially careful to let each leaf overlap slightly so as to avoid gaps and spaces. Lay on whole leaves as far as space permits and then proceed to gild the curves and corners which need smaller pieces. Place a leaf flat and smooth on the cushion and then taking the knife in the right hand draw the edge easily and evenly along it with a gentle pressure. Divide the leaf into as many pieces as required and lay on as before. When all the ground is complete, inspect it carefully to make sure there are no portions left ungilt, however small, and mend at once. Next, with a piece of cotton-wool, gently dab or press the gold down all over, finally brushing off the superfluous gold either with cotton-wool or a camel's-hair brush. It is a good plan to stipple the gold with a large stiff hog's-hair brush, quite dry and clean, as this gradually softens and removes the marks of joining and other imperfections. Finally smooth the gold with a clean piece of wash-leather, and it is completed.

Gilding with Japanner's Size.

With regard to gilding with japanner's size, the same directions apply, except as to the time necessary to wait between sizing and gilding. If japanner's size is used pure, it will be ready in from 20 to 30 minutes, but better gilding can be made by mixing one-third oil size with two-thirds of japanner's size. This will be ready in about 2 to 4 hours from the time of putting on. When all the gilding is finished, dilute 1 part of very clean and pure parchment size with 2 parts of water and brush it over the entire surface of the gold to enrich and preserve it. If it is necessary to gild in a position much exposed to the touch or to wear, as in the base of a pillar or string course, it is as well to give the gold a coat of mastic varnish thinned with turpentine.

There are various processes which tend to enrich and vary the effect of gilding. Glazings of transparent colors are sometimes applied for the purpose of deadening the lustre. Raw sienna passed thinly over a sheet of gold gives it a leathery appearance. A good effect may be produced by stencilling a small pattern in umber, sienna or Indian red over gold, especially if there is foliage or arabesque work upon the gilding, as a small design affords an agreeable relief. This is the easiest mode of gilding; any other metallic leaf can be applied in the same manner.

Gilding and Silvering Leather.

Soak thoroughly tanned leather, free from all fatty substances, in a medium strong bath of caustic soda for

a time varying according to its thickness. When taken out, dry and saturate it with a solution of isinglass and alum. After drying in the air, it is coated twice, according to its quality, with a mixture of 2 lbs. of collodion and 1 drachm of castor oil. It is again dried and then treated with a weak solution of caoutchouc in benzine, after which the gilding varnish prepared from old linseed oil varnish boiled with litharge and Venice turpentine, is applied. When so far dry that it is only slightly sticky, the gold or other leaf is laid on, brushed over, and, finally, to protect the gilding, coated with a solution of mastic in alcohol.

Silvering Glass Without Heat.

There are many ways of silvering glass, among which is the following, selected for its simplicity: A shallow pan or dish, only slightly larger than the plate of glass itself, is required for holding the silvering solution. It should be perfectly level on the bottom and at least half an inch deep. First make a reducing solution (*a*) by first dissolving and then boiling 12 grains of Rochelle salts in 12 oz. of distilled water. While this is boiling add 16 grains of nitrate of silver, dissolved in 1 oz. of water, and boil ten minutes longer. Then remove from the source of heat and add enough cold water to make 12 oz. in all.

Next make a silvering solution (*b*) by dissolving 1 oz. of nitrate of silver in 10 oz. of distilled water; slowly add liquid ammonia until the brown precipitate is nearly but not quite all dissolved. Then add 1 oz. of 95% alcohol and sufficient water to make 12 oz. in all. Take

equal parts by weight of solutions *a* and *b*, mix them thoroughly, cover the bottom of the silvering dish with the fluid and lay the glass (which has been previously cleaned with soda solution and rinsed with clear water) while still wet, face down in the mixture. Let it remain in the dish or pan for about 20 minutes or thereabouts, rocking it gently near an open window; then take out the glass and stand it on edge to drain. The solutions should stand a few days before being used, so as to allow them to settle, and only distilled water should be used in making them. One drachm of each solution will be required for each square inch of surface.

Draper's Method of Silvering Glass Without Heat.

Dissolve separately 500 grains of Rochelle salts in 3 oz. of distilled water and 800 grains of nitrate of silver, also in 3 oz. of water. Add of the silver solution to 1 oz. of strong liquid ammonia until brown oxide of silver remains undissolved. Then add, alternately, ammonia and silver solution carefully until the nitrate of silver is exhausted, when only a very little of the brown precipitate should remain; then filter. Just before using add the Rochelle salts solution and dilute the mixture with distilled water to make 22 oz. in all. Clean the glass or mirror with nitric acid or plain collodion and tissue paper. Coat a tin pan of suitable size with beeswax and rosin, equal parts melted together. Fasten a stick, one-eighth of an inch in thickness, across the bottom of the pan and pour in the solution. Put the glass in quickly, face downwards, one edge first; carry

the pan to the open window and rock the glass slowly for half an hour. Bright objects should now be scarcely visible through the film. Remove the glass and set on its edge on blotting paper to dry, and when thoroughly dry, lay it face up on a table free from dust. Stuff a piece of soft buckskin with cotton-wool loosely and go over the whole surface with this rubber in circular strokes. Put some fine rouge on a piece of buckskin and impregnate the rubber with it, polishing the silver in small circles, going gradually over the whole surface. After one hour of continual rubbing, the surface will be polished perfectly opaque, and, with care, free from scratches. It is best before silvering to heat the solution and the glass in water to 100° F.

Processes for Coating Metals With Silver.

No. 1.—Dissolve $3\frac{3}{4}$ oz. of silver in 7 oz. of nitric acid in a well-closed vessel. Separately dissolve 2 lbs. of cyanide of potassium in $2\frac{3}{4}$ lbs. of water. Filter and mix the two solutions, then add $6\frac{3}{4}$ oz. of whiting and put the fluid in green bottles. To silver the article, mix 1 part of the fluid with 3 parts of water and steep the article in the liquid until a sufficiently thick deposit of silver is attached. Polish with chalk.

No. 2.—First cleanse the surface of the article to be silvered, and then wash it with a solution of nitrate of silver so that a thin film is formed. When dry, expose the article to a current of sulphuretted hydrogen gas. The coating thus produced is very conductive and a deposit of silver adheres very firmly to it when the article is put into the electroplating bath.

Silvering Fluid.

First make a mixture of 2 oz. of quicklime, 5 oz. of grape-sugar (glucose), 2 oz. of tartaric acid and 650 oz. of water. Second, dissolve 20 oz. of nitrate of silver in 20 oz. of liquid ammonia and add 650 oz. of water. When about to be used, mix the two fluids together, shake well and filter, then steep the article in the fluid until a deposit of silver is evident. Metal, bone, ivory, wood and textile tissues may be silvered by this means.

Silvering Copper Articles.

Make an amalgam by rubbing up in a porcelain mortar, 1 oz. of the finest tin filings with 2 oz. of mercury until a semi-solid compound is produced. Then add 1 oz. of silver (precipitated from nitric acid solution by means of metallic zinc, and thoroughly washed). When the mixture has become homogeneous by rubbing together, mix it thoroughly with about 8 oz. of bone dust. The silvering process is carried out by rubbing the amalgam on the article by means of a moist cloth dipped in the amalgam. A coating of silver is at once deposited which is fairly durable. Finally polish the article by rubbing with a dry cloth. If many and large pieces are to be silvered, it is better to amalgamate the surfaces first by an instantaneous dip into a saturated solution of mercury in nitric acid. This process is technically called "quicking."

Process of Silvering Mirrors for Telescopes.

Take a mold of a convex shape, made of a mixture which is either an electrical conductor itself or else a

conductor metallized by the aid of nitrate of silver and phosphorus dissolved in sulphide of carbon. In either case, the mold is plunged in an electroplating bath of silver, when the current, conducted very slowly to the mold, produces a deposit of excellent quality. When the silver deposit has become as thick as an ordinary sheet of paper, the bath is replaced by one of copper to obtain a solid backing. The mold is then dissolved or melted and the mirror removed, when it only needs to be polished to fit it for use.

To Coat Bessemer Steel With Silver.

The article is first cleaned of all grease by washing in hot lye, rubbed with diluted hydrochloric acid, and scoured with sand. Solution of mercury in nitric acid is dropped into water slightly acidulated with hydrochloric acid, until the fluid becomes covered with a white coating. But as iron does not amalgamate like other metals by dipping it simply into the fluid, it is connected with the zinc pole of a Bunsen cell and submerged in the solution of mercury. The Bessemer steel will then acquire a coating of mercury; it is taken out, thoroughly washed, and silvered in the usual silver bath. The articles are taken from the silver bath, thoroughly washed, and heated upon a coal fire until they hiss when touched with the finger. They are then allowed to cool off, scratch-brushed, and, if necessary, polished.

Silvering Process for Iron and Steel.

Make an alloy of 80 parts of tin, 18 parts of lead and 2 parts of silver, or else 90 parts of tin, 9 parts of lead and 1 part of silver. First melt the tin and when

the bath has acquired a white lustre, add the granular lead and stir the mixture with a stick of pine. The melted silver is then added and the compound well stirred. The heat of the fire is now raised until the surface of the bath assumes a light yellow color, when it is vigorously stirred and the alloy poured out into molds. The process of silvering steel is carried out in the following manner:

The article is dipped in a dilute solution of sulphuric or hydrochloric acid, consisting of 1 to 10 parts of acid to 100 parts of soft water. After removal from this acid bath it is at once rinsed off in clean water, then dried and rubbed with a piece of soft leather or a dry sponge. It is then placed in a muffle and exposed for five minutes to a temperature of 150 to 175° F., the object of this operation being to prepare the steel for the reception of the alloy, making it, so to speak, porous. The article, while still retaining a heat of 120 to 140° F., is dipped in the above-mentioned alloy, which has been melted in a crucible of graphite or refractory clay over a moderate fire, the bath must be entirely liquid and stirred with a stick of pine or poplar wood. The surface of the bath should have a beautiful white silver color, two to five minutes being usually sufficient for immersion. After the article has been taken from the bath, it is dipped in cold water or otherwise treated as may be necessary for handling it, if required, but it must not be kept too long in the water, as this frequently renders it brittle. Nothing further is necessary other than dipping the article, then rubbing and subsequently polishing.

To protect the articles against acids, they are dipped into a bath of 60 parts of mercury, 39 of tin and 1 of silver. While warm they are dipped in melted silver or plated by the electrolytic process.

Gilding By Dipping.

Articles of steel, copper, silver and other of the baser materials may be gilded by immersing in a weak solution of chloride of gold. This is, however, more interesting as a fact than of practical value.

Solution for Gilding Brass and Copper.

Fine gold, $6\frac{1}{4}$ dwts. Convert the gold into chloride and dissolve in 1 quart of distilled water, then add 1 lb. of bicarbonate of potassium and boil the mixture for two hours. Immerse the article to be gilded in the warm solution for a few seconds, up to one minute, according to the activity of the bath.

Another method of gilding brass and copper articles, by simple immersion, is to first dip in a solution of proto-nitrate of mercury (made by dissolving quicksilver in nitric acid and diluting with water), and then dipping them in the gilding liquid. It is said that copper may be gilded so perfectly by this method as to resist for some time the corrosive action of strong acids. During the action which takes place, the film of mercury, which is electro-positive to the gold, dissolves in the auriferous solution and a film of gold is deposited in its place.

Process of Gilding.

Place in a plate leaf gold, add a little honey, stir the two substances carefully together with a glass stopper, the lower end of which is very flat. Throw the resulting paste into a glass of water mixed with a little alcohol, wash it and leave it to settle. Decant the liquid and wash the deposit again. Repeat the same operation until the result is a fine, pure and brilliant powder of gold. This powder, mixed with common salt and powdered cream of tartar and stirred up in water, serves for gilding.

Gilding Solution.

One part of chloride of gold, 10 parts of ferrocyanide of potassium and 100 parts of water. Dissolve the salts in the water and then filter. In general the tone of the gilding varies according as the solution is more or less diluted. The color is most beautiful when the liquid is most dilute and most free from iron (from the ferrocyanide). To make the surface appear bright, it is sufficient to wash the article in water acidulated with sulphuric acid, rubbing gently with a piece of cloth.

Solution for Gilding Bronze.

Small articles may be gilded by immersing them in the following solution, which must be used at nearly boiling heat: 180 parts of caustic potash, 20 parts of carbonate of potash, 9 parts of cyanide of potassium and 1,000 parts of water. Rather more than 1½ parts of chloride of gold is to be dissolved in the water, when

the substances are to be added and the whole boiled together. The solution must be strengthened from time to time by the addition of chloride of gold, and also after being worked four or five times, by the addition of the other salts, in the proper proportions given. This bath is recommended chiefly for gilding economically small articles of cheap jewelry and for giving a preliminary coating of gold to large articles which are to receive a stronger coating.

Coloring Processes.

When gilding is of an inferior color, it is sometimes necessary to use some process to improve the color. There must be always a sufficient coating of gold upon the article to withstand the action of materials employed. This condition being fulfilled, the artificial coloring processes may be applied with advantage and gold surfaces of great beauty obtained. Two dwts. of sulphate of copper, 4 dwts. of French verdigris, 4 dwts. of salammoniac, 4 dwts. of nitre and about 1 oz. of acetic acid. The sulphate of copper, salammoniac and nitre are first pulverized in a mortar, then the verdigris is added and well mixed with the other ingredients. The acetic acid is then poured on a little at a time, and the whole worked up together, when a thin mass of a bluish-green color will result. The article to be colored is to be dipped in the mixture and then placed on a clean piece of sheet copper which is next to be heated over a clear fire until the compound assumes a dull black color. It is now allowed to cool and is then plunged into a tolerably strong sulphuric acid pickle which soon dis-

solves the coloring salts, leaving the article a fine gold color. Rinse well in cold water to which a small quantity of carbonate of potash should be added. Next brush with warm soap and water, then rinse in hot water.

Coloring Gilt Work.

In working gold solutions employed in the dipping process, it may sometimes occur that the color of the deposit is faulty and patchy instead of being of the desired gold color. To overcome this, certain coloring salts are employed, the composition of which is as follows: Nitrate of potash, sulphate of zinc, sulphate of iron, alum, of each equal parts. These substances are placed in an earthenware vessel and melted at about the temperature of boiling water. When fused, the mixture is ready for use. The articles are to be brushed over with the composition and then placed in a charcoal furnace and heated until by applying the moistened tip of the finger to one of the pieces, a slight hissing sound is heard. This indicates that the heat has been sufficient. Then the articles should be at once removed and thrown quickly into a very weak sulphuric acid pickle which dissolves the salts and leaves the work clear and bright. The coloring process has a rather severe action upon gilt work and should not be used when the gilding is a mere film.

Silvering Powder for Coating Copper.

Mix together:

80 grains of nitrate of silver,
40 grains of common salt,
7 drachms of cream of tartar.

For use, moisten with water and rub it over the copper surface.

Silver Wash for Plated Silverware That Has Lost Its Silver Coat.

Mix 1 part of chloride of silver with 3 parts of pearl-ash, 1½ parts of common salt and 1 part of whiting, and rub the mixture on the surface of brass or copper that shows through the silver coating, which should be perfectly cleaned by means of soft leather or a cork moistened with water and dipped in the powder. When properly silvered, the metal should be well washed with hot water that is slightly alkalized and then wiped dry.

To Silver Glass.

There are many methods of effecting this, some of which have been given, but the following is a very simple method and efficacious:

(*a*) Reducing Solution.—Dissolve 12 grains of Rochelle salts in 12 oz. of water and boil. Add, while boiling, 16 grains of nitrate of silver, dissolved in 1 oz. of water, and continue the boiling for ten minutes more; then add water to make 12 oz.

(*b*) Silvering Solution.—Dissolve 1 oz. of nitrate of silver in 10 oz. of water, then add liquid ammonia until the brown precipitate is nearly but not quite all dissolved; then add 1 oz. of alcohol and sufficient water to make 12 oz.

(*c*) To Silver.—Take equal parts of *a* and *b*, mix thoroughly, and lay the glass face down on the top of the mixture while wet, after it has been carefully cleaned

with soda and well rinsed with clean water. Only distilled water should be used for making the solutions.

About 2 drachms of each will silver a plate two inches square. The dish in which the silvering is done should be only a little larger than the plate. The solution should stand and settle for two or three days before being used, and will keep good a long time.

To Silver Glass Balls.

Lead and tin, each 2 oz., 2 oz. of bismuth, 4 oz. of mercury. Melt together in order given. Have the globe perfectly clean and dry. Warm it, melt the amalgam, pour it in and roll it about until the glass is coated. Too high a heat in use will spoil them.

To Silver Glass Globes.

1 oz. of nitrate of silver,
3 oz. of distilled water,
3 oz. of alcohol,
1 oz. of ammonia, about,
2 oz. of grape sugar.

Dissolve the nitrate of silver in the water, add the ammonia in a quantity just sufficient to redissolve the precipitate formed at first, add the alcohol and allow it to rest for four or five hours. The grape sugar is dissolved separately in 1 oz. of water and added to the silver solution at the moment of using. The glass globes being perfectly clean, the solution is poured into them and the globes are turned on all sides in front of a moderate fire so that the liquid touches every part alike. The coating is done in a few minutes, when the excess

of liquid is to be removed and the globe washed with distilled water first and lastly with alcohol. The success of the operation depends in a great degree on the cleanliness of the surface of the glass to be silvered. The slightest speck of dust or grease is sure to show. A good way to clean the globes would be to wash them with a warm solution of soda, then with dilute nitric acid and lastly with alcohol, care being taken not to touch with the fingers any part of the globe which is intended to be silvered.

To Impart a Silver Surface to Brass.

No. 1.—Mix 2 oz. of chloride of silver with 5 oz. of cream of tartar, moisten the mixture with water and rub it over the brass by means of a cork dipped in it.

No. 2.—Mix and use in the same way, 1 oz. of chloride of silver, 3 oz. of pearlash, 1 oz. of whiting and 1½ oz. of common salt. It is needless to say that the coat of silver thus imparted is not very durable and soon wears off the brass.

To Silver Glass Balls.

Melt together in the order in which the ingredients are given:

2 oz. of lead,
2 oz. of tin,
2 oz. of bismuth,
4 oz. of mercury.

Have the globe perfectly clean and dry. Warm it, melt the above amalgam, pour it in and roll the globe

about until the inside of the glass is coated. Too high a heat in use will spoil them. The amount of mercury can be lessened by one-half. The lead and tin are usually melted first, after which the bismuth is added. The dross is scraped off and the mercury added. Leaves of Dutch metal are sometimes added, according to the color which it is desired to impart to the globes.

To Silver Glass Globes.

Dissolve 1 oz. of nitrate of silver in 3 oz. of distilled water, add sufficient (about 1 oz. is usually enough) ammonia to redissolve the precipitate that is at first formed, then add 3 oz. of alcohol and allow the mixture to rest for four or five hours, then filter. Separately dissolve 2 oz. of grape sugar in 1 oz. of water and add to the silver solution at the moment of using. Then pour this fluid into the globes and treat them as described for balls.

To Silver Cast Iron.

To silver cast iron, 15 grains of nitrate of silver are dissolved in 250 grains of water and 30 grains of cyanide of potassium are added. When the solution is complete, the liquid is poured into 700 grains of water, wherein 15 grains of common salt has been previously dissolved. The cast iron intended to be silvered by this solution should, after having been well cleaned, be placed for a few minutes in a bath of nitric acid of 1.2 specific gravity, just before being placed in the silvering bath.

Silvering of Metals.

Small articles may easily be coated with silver by dipping them first into a solution of common salt and rubbing with a mixture of 1 part of precipitated chloride of silver, 2 parts of potassa alum, 8 parts of common salt and the same quantity of cream of tartar. The article is then washed and dried with a rag.

To Silver Plaster.

Ordinary plaster models are covered with a thin coat of mica powder, which perfectly replaces the ordinary metallic substances. The mica plates are first cleaned and bleached by fire, boiled in hydrochloric acid, and washed and dried. The material is then finely powdered, sifted and mingled with collodion, which serves as a vehicle for applying the compound with a paint brush. The objects thus prepared can be washed in water, and are not liable to be injured by sulphurous acids or dust. The collodion adheres perfectly to glass, porcelain, woods, metals or papier-mâché.

To Silver Shells.

Grind silver leaf in gum water to the required thickness and apply to the inside of the shell. For gold color, grind gold leaf in gum water.

Preparation of Silver Size.

Put in a pan 4½ oz. of Spanish chalk, ½ oz. of Venetian soap, ½ oz. of beeswax and 9 oz. of finely-pulverized fat pipeclay; roast thoroughly. Rub fine with the

white of 40 eggs. Form the mass into small balls and dry upon a glass plate. To apply the size, triturate a piece with wax, then put it in a glass and dilute with water. Brush the frame with the dissolved size and let it dry before applying another coat.

PAPER AND FABRICS.

Preparation of Luminous Paper.

The luminous mass or compound consists of:

4 parts of potassium bichromate,
4 parts of gelatine,
50 parts of calcium sulphide.

The constituents are thoroughly dried and mixed by grinding. One part of the resulting powder is stirred with 2 parts of boiling water to a thickly fluid paint, one or two coats of which are applied with a brush to the paper or pasteboard to be made luminous. To avoid inequality in the thickness of the layer of paint, the paper is passed through a sort of callender with rolls at a proper distance to ensure a uniform spreading of the luminous mass. The rolls may be heated if desired.

Preparation of Oil-Proof and Water-Proof Papers.

Dip the parchment paper in a hot solution of gelatine to which has been added 2½ or 3% of glycerine, and dry. To make the same parchment paper water-proof, soak it in a solution of 1% of linseed oil and 4% of caoutchouc in carbon bisulphide.

Decorating Textiles and Fabrics With Metallic Coatings.

Make a thin paste with pure zinc dust and albumen and spread it with a brush or roller upon linen or cotton

tissues. When dry, the albumen is coagulated by steam and the fabric immersed in a solution of chloride of tin. The tin is deposited in a fine powder on the zinc. Beautiful effects can be made by burnishing the whole or parts of it.

Painting on Silk, Satin, Shirting or Linen.

The principal object to be obtained in preparing the fabric is to take care that the stuff does not become too brittle from painting upon it. This is prevented by using the colors as flat as possible so that the material does not strike in the fabric too much. In order to stop the colors from coming through on the other side, a size made from 4 parts of gelatine and 10 parts of water, with from 10 to 20 drops of glycerine added to each 5 oz. of the gelatine and water solution, should be applied on shirting or linen over all the design, while on silk or satin only the outline of the design should be sized. The size must be dry to the touch before beginning to paint. Tube colors in oil are the best suited for the purpose and several applications are requisite to bring out the effect properly. The colors must be as free from oil as possible, especially on the first coat. To make the colors less oily, extract some of the oil from the color by placing it on blotting-paper for a short time. Use brushes or pencils with bristles as short as possible and trim them to suit. If any part of the painted surface should be matt, go over it with a good pale coach varnish of the proper elasticity. For large surfaces it is best to draw as much of the oil from the colors as possible, and add to the color a little heavy painter's

varnish and enough turpentine to make it flow freely from brush or pencil. For sizing silk or satin that is not exposed to dampness, 1 part of white of egg and 2 parts of water will answer very well.

To Silver Ribbons.

Make a solution of nitrate of silver and add a little gum to it so that the liquid will not run. Then with a camel's-hair pencil or pen draw any sort of ornamental figure on the ribbon. After the drawing is dry, hold the ribbon over a vessel containing water, zinc and a little sulphuric acid. In a short time the silver will be reduced and adhere quite strongly to the fabric.

To Impart an Iridescent Appearance to Paper.

Boil together and strain through a cloth, $6\frac{3}{4}$ oz. of powdered gallnuts, $4\frac{1}{2}$ oz. of sulphate of iron, $\frac{3}{4}$ oz. of sulphate of indigo, 18 grains of gum arabic. Brush this compound over the paper and expose to the vapor of ammonia.

IMITATIONS.

Imitation of Mother-o'-Pearl and Marble With Glue.

The following process for the sake of clearness is divided into five principal operations, the first of which is the preparation of the plates. Both enamel and glass plates are used for imitation of marble, but only glass plates are employed for imitation of mother-o'-pearl. The glass plates must be ground but need not exceed 1-10 to 1-7 inch in thickness and only require careful washing and drying for imitation of mother-o'-pearl. For imitation of marble they should be rubbed with an oiled rag. Fine plates after being washed are polished with pure colcothar and water and wiped with a soft rag to remove any particles of the polishing powder. The polishing paste is then gently rubbed with a rag dipped in pure Spanish chalk (soapstone) and the excess of chalk carefully wiped off.

The second operation is the prepartion of the glue solution. For 1 dozen plates, each 1 square yard, soak 2 lbs. of good colorless glue in water for 24 hours. Then pour off the water and melt the glue in a waterbath and stir in 3½ oz. of glycerine. For imitation marble with two colors, compound 1 to 1½ parts of this glue solution with the quantities of thoroughly good mineral colors mentioned below, the rest of the glue solution

being mixed with 6½ oz. of zinc white, ground very fine. For imitating marble with three colors, mix ¾ part of the glue solution with the coloring matter and ¾ part with the other coloring matter, and the remainder with zinc white. For imitating marble with four colors, take ½ part of the glue solution to each of the three coloring matters, and mix the rest with 4½ oz. of zinc white. The proportions by weight of the mixture for ten different varieties of imitations of marble and enamel are as follows:

(*a*) Mix 1 part of glue solution with 1¾ oz. of colcothar and 2½ oz. of zinc white, and the rest of the glue solution with 6½ oz. of zinc white.

(*b*) Mix 1 part of the glue solution with 1¾ oz. of colcothar and the rest with 5½ oz. of zinc white.

(*c*) Mix ¾ part of glue solution with 1¾ oz. of zinc white and 1 oz. of colcothar, ¾ part of the glue solution with 1 oz. of yellow ochre and the rest with 5½ oz. of zinc white.

(*d*) Mix ½ part of glue solution with 1 oz. of colcothar, ¾ part of the glue solution with ¾ oz. of sepia and the rest with 5¼ oz. of zinc white.

(*e*) Mix 1 part of the glue solution with 1 oz. of quite and filtered solution of aniline black and the rest with 6¼ oz. of zinc white.

(*f*) Mix ½ part of glue solution with ¾ oz. of colcothar, ½ part of the glue solution with ¾ oz. of yellow ochre, ½ part of the glue solution with ¾ oz. of soap and the rest with 4½ oz. of zinc white.

(*g*) Mix 1 part of the glue solution with 1½ oz. of lampblack. For gray add sufficient zinc white to pro-

duce the desired shade. The rest of the glue solution is mixed with 6½ oz. of zinc white.

(*h*) Mix ½ part of the glue solution with ¾ oz. of umber, ½ part of the glue solution with ¾ oz. of bole, ½ part of the glue solution with ¾ oz. of ochre and the rest with 4½ oz. of zinc white.

(*i*) For enamels, mix 1 part of the glue solution with 1 oz. of minium and the rest with 6 oz. of zinc white.

(*k*) Mix 1 part of the glue solution with 1½ oz. of chrome green and the rest with 6¼ oz. of zinc white.

For Imitating Mother-o'-Pearl Veneers.

Grind up ½ oz. of silver bronze with a little glue or water, and intimately mix with the above glue solution. The bronze powder must be in a dry state when stirred into the glue or lumps would be formed and the veneers become spotted.

In place of bronze, essence of fish-scales, which is of course expensive, may be used. This essence is made by washing fish-scales from mackerel, while fresh, free of skin, etc., and keeping them in alcohol. A solution of glue thus prepared is then compounded with different aniline dyes, according to the colors desired.

(*a*) For preparing yellowish veneers, the glue solution is used without an addition of coloring matter or with an addition of various solutions of picric acid.

(*b*) For colorless veneers or those of slightly reddish tint, a smaller or greater number of drops of concentrated solution of fuchsine are added, which counteracts the yellowish tint of the glue. For those imitations of mother-o'-pearl veneers, a concentrated solution of gela-

tine compounded with 1 oz. per cwt. of glycerine can be employed, especially when essence of fish-scales is used.

(*c*) For Blue. The glue solution is compounded with Blue de Lyons, but the greatest care must be experienced not to use too much or the imitation becomes indistinct. The right degree of shade can be tested by allowing a few drops of the colored glue solution to fall upon a glass plate. For red, a solution of fuchsine or carmine is used; the latter is obtained by dissolving commercial carmine powder in alcohol.

Orange colors are produced by a solution of resorcine. Violet, by adding dahlia violet. To these, as well as for the solution colored with fuchsine, the plates must not be rubbed with oil, as even the smallest trace of oil discolors their color in drying, or at least the veneer will show colorless spots. The different shades of gray are obtained by adding more or less of aniline blue which has been previously filtered.

Pouring the Colored Glue Solutions Upon the Plates.

For imitations of marble and enamel, the glass plates rubbed with oil are placed in a horizontal position with the rubbed surface up. The proper position of the white ground mass, after it has become somewhat thick, is then poured upon the plates and the gaps left free in pouring are filled in and smoothed with an instrument resembling a knife and made of horn or bone. Upon this white ground the respective colored solutions of glue are then poured in zigzag form, parallel veins or spots, and, according to the desired design, drawn through the

ground with a glass rod. If several differently colored glue solutions are to be applied, as given, for instance, under No. 2, they should be poured in quick succession, so that the succeeding color contacts or that a white strip or spot remains between each color. The whole is intermingled with the glass rod according to the design. If the latter is to have sharply-defined lines and spots, the respective glue solution is used somewhat thicker, but if, on the other hand, the design is to be blended, the glue solutions are used somewhat warmer. The plates, when the glue has become solid, are placed until further treatment in a cool place for two or three hours.

Malachite.

Imitations of malachite are prepared in a similar manner. Four glue solutions with different shades of green to the lightest tint are prepared, and these solutions poured upon a slightly greenish-colored ground in imitation of the curves and veins peculiar to malachite. These curves and veins are then traced with a comb with teeth standing at equal distances from each other.

The glass plates set aside to be used for imitations of mother-o'-pearl are now taken in hand. The glue solutions must be kept warm in a waterbath and thoroughly stirred every time before pouring them upon the plates, and the formation of a skin on the surface of the glue must be strictly avoided. For pouring out the solutions it is best to use a porcelain dish with a spout and a handle and having the capacity of about 12 cubic inches. The portion of glue solution required for each plate ($1\frac{3}{4}$ fluid oz.) is now measured into the porcelain dish

and after allowing it to stand a little while it is poured upon the plate and uniformly distributed.

The production of the mother-o'-pearl design requires some skill and practice. A comb with teeth set ½ inch apart is used for this purpose. It is held in a somewhat oblique position, the teeth are gently pressed upon the glass plate, and with frequent turnings of the comb at a right angle, cycloidal motion is executed.

The treatment is commenced from the front to the back edge of the plate, and when the glue begins to thicken on the edges, continued at the softer places until the desired design is produced. The places, after the glue has acquired the necessary degree of solidity, must not be retouched with the comb. When all the plates have been treated in this manner they are then set aside for two or three hours.

Transferring the Layer of Glue to the Layer of Gelatine.

For each dozen of veneers soak 2½ oz. of gelatine. Then melt it in a waterbath and add glycerine equal to 10% of the gelatine and let the mixture settle. The glass plates treated with colcothar and Spanish chalk (soapstone) are now placed in a horizontal position; 1 gill of the gelatine solution is poured on and the gaps filled in by means of the glass rod. The front edge of the plate covered with the colored layers of glue is now, glued side down, laid exactly upon the front edge of the gelatine plate, while the back edge of the former is gradually lowered until the plate lies firmly upon the gelatine. We will here remark that the gelatine solution must only be cooled off so far that the glue will not

melt on touching it. If it is cooler, the veneers will be blistered. Care must be taken that before placing the first plate upon the gelatine, no gelatine escapes, but that any excess of the latter only runs off after the back edge of the first plate touches that of the latter.

The plates are now allowed to rest quietly until the gelatine is congealed, when they are removed to a cool place where they remain for five or six hours.

The imitations of mother-o'-pearl are treated in the same manner, with the exception that the gelatine solution is colored with the same matter as the glue solution. For the colorless or yellowish veneers, the gelatine solution is not changed.

After six hours the first glass plate is detached from the layer of glue by loosening the latter around the edge with a knife blade and the plate gradually lifted off, commencing at one corner. With some care this is easily accomplished without detaching the gelatine layer.

Drying and Detaching the Veneers.

The veneers, with the gelatine layers still adhering to the glass plates, are dried. This is effected in a heated room in which the veneers are arranged upon frames so that they stand almost perpendicular. The hot air enters near the ceiling of the room while the moist air is swept away near the floor. The temperature of the lowest zone where the fresh plates are placed should not exceed 68° F. The plates are moved higher up every day until they become thoroughly dry. The veneers, before removing them from the room, must be tested in regard to their dryness. They are sufficiently dry when

on pressing the finger-nail upon the glue no impression is made.

The plates after removal from the room are allowed to cool off for at least three hours before the veneers are detached from the glass plates. Operation begins by detaching the gelatine layer on the edge with a very thin knife blade. The operator then takes hold of one corner of the veneer and draws it gradually and carefully from the glass plate. The edges of the veneers are then trimmed and they are ready for use.

If the veneers are to resist the action of water, mix with the solution of gelatine a compound with glycerine, ½ fluid oz. of a solution of 5 parts of chrome alum in 100 parts of water to every plate. Immerse the veneers for a short time, after they have been detached from the first plate, in a similar solution of chrome alum.

The veneers prepared by this method can be used for various purposes in architecture; also in the manufacture of furniture and for coating columns for inlaid work, etc. Add some glycerine to the glue with which they are to be fastened to the articles. This will prevent them from blistering and coming off.

Imitation Coral.

Alabaster is generally used for making imitation coral. For the purpose of drying them, prepare a bath of 1 part of tartar, ½ part of composition of tin and 70 parts of water. The composition of tin is prepared from 8 parts of nitric acid, 1 oz. of salammoniac, 1 oz. of tin and 25 oz. of water. Saturate the bath with cochineal and raise it to the boiling point; then allow

it to cool and decant the clear fluid from the dregs. Steep the alabaster in this fluid and then boil for one hour. Dry in the open air and finally put into a bath composed of equal parts of stearic acid and wax for two to three hours. After removal from this wax bath, wipe off the paper and polish with a cloth.

To Make Imitation Cameos.

Make marble cement into a thin paste with a mixture of yolk of egg and water. The paste can be colored as desired and is then put into molds by means of a brush. Before putting the cement in the molds they should be silvered and oiled. The figure of the mold is first filled with the paste and when this is cold the mold is filled with a paste of a different color. When all is hard, the cameo is dried, figure-side up, then dusted with soapstone and brushed with a soft brush. It may also be saturated with stearine by warming the cameo or by laying on a hot solution of wax.

To Dye Horn in Imitation of Tortoise-Shell.

No. 1.—Mix orpiment (yellow arsenic sulphide) with lime-water and apply with a brush.

No. 2.—Use nitrate of mercury. This gives a brown stain. The different dyes can be used on the same piece of horn.

DECORATION OF PORCELAIN.

Painting Glass, Porcelain, Etc.

To prepare the flux, melt in a saucer or Berlin evaporating dish, 30 parts of rosin, and add, during the melting, 10 parts of basic nitrate of bismuth in small portions with constant stirring. When the mixture begins to assume a brown color, pour 40 parts of oil of lavender into the saucer and stir until the ingredients are thoroughly combined. Then remove the saucer from the sand bath and allow the contents to cool. Add 35 parts of oil of lavender and the flux is ready for use. The coloring matters are salts, oxide of antimony, chromium, cobalt, copper, iron, iridium, palladium, platinum, rhodium, silver, uranium, zinc and gold, if mother-o'-pearl or a prismatic play of colors is to be produced.

Metallic Colors for Decorating Porcelain.

Prepare a mixture of a solution of a zinc salt and a solution of a salt of some other metal. Evaporate the mixture to the consistency of dough and heat in a refractory clay retort. As soon as the residue assumes the desired color, the heated product is withdrawn from the furnace. This solution of zinc salt is used for preparing the solution of metallic color.

Bronze Color.

Add to the zinc solution, 3 parts of a solution of nitrate of cobalt and of 15 to 19 parts Beaume of a solution of nitrate of nickel and 1 to 1½ parts of a solution of nitrate of silver.

For Gold Lustre.

Melt in a porcelain dish or saucer over a sand bath, 30 oz. of colophony and add 10 oz. of uranic nitrate, and while constantly stirring, add 30 to 40 oz. of oil of lavender. By intimately mixing the mass thus obtained with a like quantity of bismuth glass (prepared by fusing together 4 oz. of oxide of bismuth and 4 oz. of crystallized boracic acid) a brilliant yellow color will result after fusing.

Copper-Red Lustre.

Melt in a saucer, 15 oz. of colophony and mix with it gradually, and with constant stirring, 15 oz. of ferric nitrate and 18 oz. of oil of lavender. When the mixture is homogeneous, take it from the fire, allow it to cool, then add 2 oz. or more of oil of lavender. By mixing 1 part of this mass with 2 parts of bismuth glass (see gold lustre above), orange, red and all intermediate colors can be obtained, according to the quantity of bismuth glass used.

Orange Lustre.

Mix and rub up in a mortar, 2 oz. of uranic oxide, 1 oz. of chloride of zinc and 3 oz. of bismuth glass.

Prismatic Colors for China.

Rub up on a plate, cyanide of gold with mercuric cyanide so that a paste is formed. Allow this to dry and then rub it up with oil of lavender. This auriferous compound is mixed with three to ten times its quantity of bismuth glass.

Yellow.

Add to a solution of zinc solution $1\frac{1}{2}$ to $2\frac{1}{2}$ parts of a solution of ferric sulphate of 28 to 30 Beaume.

Gray.

Add $2\frac{1}{2}$ parts of a solution of blue nitrate to a solution of zinc.

Green.

Add $2\frac{1}{2}$ parts of a solution of nitrate of cobalt of 20 Beaume to a solution of zinc salt.

Rose-Red.

Add 2 to 3 parts of a solution of ferric nitrate of 20 to 25 Beaume to a solution of zinc salt.

Golden Yellow.

Add 2 parts of a solution of nitrate of magnesia of 12 to 16 Beaume and a few drops of a saturated solution of silver to a solution of zinc salt.

Yellowish Green.

Add 2 parts of a soluble nitrate of nickel of 15 to 16 Beaume to a solution of zinc salt.

Decorative Lustre Ware.

The old-time copper-colored lustre ware that was so popular fifty or sixty years ago is seldom seen now, yet most of it is more decorative than much of the highly-colored, elaborately gilt ornaments so prevalent. There is no reason why this lustre ware should fall out of use, as it is as easy to produce it as to produce over-glaze painting or decorating vases, etc.

When laid on biscuit, coated with a solution of uranium, light and dark iridescent colors are obtained. The colors may all be mixed together or applied on top of the other. Mother-o'-pearl colors can be easier produced upon glass than upon porcelain. For the latter it is necessary to mix the bismuth glass with lead glass and frequently chloride of antimony mixed with rosin must be added.

Dark Purple.

Dilute a clear solution of 1½ drachms of gold in aqua regia with 20 lbs. of distilled water and add, with constant stirring, 1½ drachms of a solution of protochloride of tin. The fluid will assume a deep brown-red color and precipitation will take place on adding a few drops of sulphuric acid. The fluid is now poured off, the precipitate washed five or six times with water and then collected in a filter, where it is allowed to drain off. While still moist it is placed with a silver spatula upon a glass plate and intimately mixed with 3 drachms of very fine lead glass, obtained as above. The mixture is dried, then mixed with 1½ drachms of carbonate of

silver and rubbed fine. About ½ oz. of dark purple will be obtained in this manner.

Pale Purple.

Dissolve 1½ oz. of shavings of iron in boiling aqua regia, and concentrate the solution in a water bath until it becomes solid. In this manner chloride of tin is obtained containing hydrochloric acid in excess, which is dissolved with a little distilled water and mixed with ½ drachm of protochloride of tin of 17 specific gravity. The solution of tin is then gradually mixed in a large beaker glass with 2½ gallons of water, but the solution should contain a sufficient quantity of acid to prevent a separation of stannous chloride. A solution of 8 grains of gold in aqua regia, which has been previously evaporated nearly to dryness in a water bath, then diluted with water and filtered in a dark room is then added to the solution of tin, which has also been diluted with water. The fluid will assume a dark-red color without a precipitate being formed. The precipitate is moderately formed by adding 1¼ oz. of liquid ammonia. Sometimes it happpens that the precipitate does not entirely settle upon adding the ammonia. In such a case the addition of a few drops of concentrated sulphuric acid will suffice to bring about the desired result. The fluid mass then is poured off as quickly as possible and the precipitate washed five or six times with fresh water. It is then collected upon a filter, allowed to drain off thoroughly, and, while still moist, placed with a silver spatula upon an opaque glass plate with 6 drachms of lead glass, previously rubbed fine. The mixture is dried

on the glass plate, upon which the gold purple has been rubbed with the lead glass, by placing it in a room free from dirt. When dry it is mixed with 50 grains of carbonate of silver. By this process a little over 1 oz. of pale purple should be obtained with the employment of 8 grains of gold.

Rose-Red Purple.

Dissolve 16 grains of gold in aqua regia and mix the solution with a solution of 1½ oz. of alum in 5 gallons of water. Add to this, with constant stirring, ½ fluid drachm of solution of protochloride of tin, 1.7 specific gravity, and then pour liquid ammonia into the fluid as long as a precipitate of alumina is formed. When the precipitate has settled, pour the liquid off, replace it with ten times the quantity of water, wash the precipitate with this and then dry it at a moderate heat. About ½ oz. of dry precipitate will be obtained, which is mixed with 40 grains of carbonate of silver and 2½ oz. of lead glass, prepared in the same manner as given under pale purple, and the mixture rubbed up on a glass plate. The gold color when washed can only be fused upon porcelain glaze, as, when subjected to a higher temperature, the gold and silver are separated in metallic form and assume a dirty brown leather-like appearance.

Dark Yellow.

No. 1.—Mix intimately, 48 parts of minium, 16 oz. of sand, 18 oz. of anhydrous borax, 16 oz. of potassium antimoniate, 4 oz. of oxide of tin and 5 oz. of ferric oxide. Fuse the mixture in a Hessian crucible until the

mass is entirely homogeneous, when it should immediately be removed, as the color will become dirty yellow.

No. 2.—This consists of 20 parts of ammonia, 2½ parts of white sand, 4½ oz. of potassium antimoniate, 1 oz. of ferric oxide and 1 oz. of oxide of zinc. The ingredients are fused in a Hessian crucible until the mass is entirely homogeneous.

Pale Yellow.

First prepare a lead glass by fusing 8 parts of minium and 1 part of white sand. Pulverize and dry this. The color is then prepared by intimately mixing together 4 parts of potassic antimoniate, 1 part of stannic oxide and 3 parts of the above lead glass. The mixture is fused in a Hessian crucible and allowed to cool, when it is comminated and rubbed fine.

Lemon Yellow.

Mix intimately, 8 parts of potassic antimoniate, 2 parts of zinc oxide and 36 parts of lead glass. Heat the mixture in a porcelain crucible until it forms a flux. It is then taken out, and when cold, rubbed fine upon a glass plate. The mass must not be fused longer than as stated or the color will become decomposed.

Uranium Yellow.

Mix 1 part of uranium oxide and 4 parts of lead glass, prepared by fusing together 8 parts of minium and 1 part of white sand. The color is then mixed and rubbed upon a stone.

Yellowish Red.

Heat anhydrous sulphate of iron by placing the saucer containing it in an open muffle furnace. Stir it constantly until the greater part of the sulphuric acid has escaped, then take it out, and when cool, wash the ferric oxide with water to remove all traces of undecomposed salt and then dry it. To produce a fusible color, mix 7 parts of this yellow red, ferric oxide and 24 parts of lead glass (produced by fusing 12 parts of uranium and 1 oz. of calcined borax), and rub up the mixture on a glass plate.

Yellow for Figures, Landscapes, Ornaments, Vases, Etc.

Add to the dark yellow color 1 and 2, some maple yellow, which is prepared by placing 1 part of tartar emetic, 2 oz. of nitrate of lead and 4 oz. of decrepitated common salt, in a Hessian crucible, submitting the mixture to a continued strong heat. The residue is broken up, washed, dried and rubbed fine.

Naples Yellow.

Mix 8 parts of Naples yellow and 8 oz. of lead glass, prepared by fusing 2 parts of uranium, 1 of white sand and 1 of calcined borax.

White (Covering).

Mix and fuse in a porcelain crucible, 1 part of minium, 1 part of white lead and 1 part of crystallized boracic acid. This color is used for marking the light-

est places of designs which cannot be produced by leaving bare the porcelain, and also for mixing only in simple quantities with yellow and green colors to make them cover better.

Dark-Red Enamel.

Rub up with water, 1 part of brown sulphate of iron and $2\frac{1}{2}$ parts of flux No. 7.

Light-Red Enamel.

Rub up with water, 1 part of sulphate of iron and 2 parts of flux No. 1.

Opaque White Enamel.

Calcine in a clay crucible, 1 part of buckshorn shavings until they are entirely white, and rub them up into a paste with 1 pint of flux No. 1. Then triturate with water, 1 part of Venetian white enamel in cakes, and 1 part of flux No. 8 and fuse the two mixtures together.

STRAW.

Bleaching and Dyeing of Straw.

Before straw is available for the many purposes for which it is used in the industrial arts, it is subjected to a bleaching process which is generally preceded by a cleansing bath. For the purpose of dissolving the natural coloring matter the straw is steeped in hot water and then treated with alkaline lye consisting of 50 parts of water, 8 parts of potash and 12 parts of soda. When taken from this bath it is successively immersed in two or three baths of weaker lye and finally rinsed in boiling water. The bleaching process commences in a chlorine bath and is finished in one of sulphuric acid.

Good results are also obtained by treating the straw, after the bleaching process, with sulphur vapors, but in order to obtain beautiful shades of color it is advisable in this case to color the straw after the treatment with a little picric acid by immersing it in a bath of 24 lbs. of water and $\frac{3}{4}$ drachm of crystallized picric acid. Besides with sulphur vapors the straw can also be bleached in the following manner: Immerse 30 lbs. of straw in warm water for a few hours, then treat it with a soda solution of 40 Beaume for six hours and boil it for one hour with 1 lb. of chloride of lime. Then add to the bath 1 oz. 12 drachms of hydrochloric acid diluted with 3 gallons of water, and allow the straw to remain in it

for half an hour, after which it is placed in a 1% solution soda bath and finally rinsed in water. By this method the straw acquires a beautiful white color and great suppleness and elasticity. Before dyeing it is advisable to thoroughly soak the straw in order to fix the color uniformly. The most important colors are black, brown and gray.

Process of Dyeing Straw.

Note.—The following proportions of ingredients are for 22 lbs. of straw.

Black, No. 1.—Boil the straw for two hours in a dye bath made of 2 lbs. of logwood and 1 lb. of sumach or gall-nuts and then place it in a bath of nitrate of iron of about 4 Beaume. Rinse and dry.

Black, No. 2.—Boil for two hours with 4 lbs. of logwood, ½ lb. of sumach and 1 lb. of fustic or turmeric. Then darken by dipping into a solution of sulphate of iron. Rinse and dry.

Black, No. 3.—Boil for two hours in a bath made of 4 lbs. of sulphate of iron, 2 lbs. of tartar and 1 lb. of sulphate of copper. Finish off in a bath made of 8 lbs. of logwood with an addition of some turmeric.

Gray.—Soak the straw in a solution of sodium carbonate with an addition of some lime to remove the sulphur. Then boil for two hours in a dye bath consisting of 4 lbs. of alum, 3½ oz. of tartaric acid, and, according to the desired shade, some cochineal, indigo or carmine. To neutralize the cochineal, add some sulphuric acid. After boiling, wash the straw in slightly acidulated water.

Brown.—Boil the straw for two hours in a dye bath made of 1 lb. 10 oz. of sanders wood, 2 lbs. of turmeric, ½ lb. of sumach and 21 oz. of logwood. Then rinse and darken according to the desired shade with 3 to 4% of sulphate of iron.

Chestnut Brown.—Boil for two hours in a dye bath made of 26 oz. caoutchouc, 2 lbs. of turmeric, 6 oz. of gallnuts and 1 oz. of logwood, and finally treat with nitrate of iron of 4 Beaume, and rinse again.

Havana Brown.—Soak the straw in a solution of 4½ to 6¼ lbs. of alum. Then dye in a bath of 13 oz. of sanders wood, 16 oz. of turmeric, 3 oz. 8 drachms of sumach and 12½ oz. of logwood, and then rinse.

Violet.—Boil for two hours with 4 lbs. of alum, 1 lb. of tartaric acid and 1 lb. of tin salt. According to the shade required, add some extract of logwood or indigo. After dyeing, wash in alum water.

Red.—The mordant consists of 1 lb. of tartar and some tin salt. Boil for two hours. Then boil for one hour in a solution made of 1 lb. of fustic, 7 oz. of turmeric, 7 oz. of madder, 16 oz. of cudbear and 16 oz. of logwood. Then add cudbear, archil or madder.

Green.—Boil for two hours in a mordant of 7 oz. of sumach, 32 oz. of alum, 16 oz. of tartar and then add some picric acid, turmeric and aniline green.

To give lustre to the article manufactured from the dyed straw, gum or gelatine is frequently used. Dyeing with the coal-tar or aniline dyes does not require the use of any mordant, as these dyes attack the organic fibre of the straw directly it comes in contact with the straw.

STAINS FOR WOODS OF VARIOUS KINDS, VENEERS, ETC.

To Stain Maple Wood Silver-Gray.

No. 1.—Upon the bottom of a watertight box place a layer of grindstone sand (from the troughs of grindstones), upon this wood, and then again a layer of grindstone sand. Then pour over it sufficient rain-water to cover the whole, and place the box in a warm place for from three to five weeks. Replace the water lost by evaporation so that the wood is never dry. By this process a beautiful silver-gray color is produced on maple and lime wood.

No. 2.—Place the wood for three or four hours in a decoction of 1 part of pulverized gallnuts in 10 parts of water, and then for one hour in a solution of sulphate of iron in 60 parts of cold water. Then brush it off with a soft brush dipped in a solution of 1 part of alum in 18 parts of water and allow it to dry. Should the color be too light, repeat the process but allow it to remain in the baths only a few minutes.

No. 3.—Pour sharp vinegar over iron filings and alum and brush the wood over with the solution until the desired silver color is obtained. Gallnuts converted into coarse powder may also be used in the place of iron filings.

No. 4.—Dissolve verdigris in vinegar or crystallized verdigris in water and paint the wood with the solution until it has acquired the tint desired. The solution may be used either warm or cold.

For Veneers.

For veneers which are to be stained through and through, place 16 parts of salammoniac and a sufficient quantity of iron filings in an earthenware pot, pour strong vinegar over them and let it stand for fourteen days in a warm oven. Then pour sharp lye into another pot, add gallnuts converted into a coarse powder, and shavings of blue Brazil wood. Let the whole stand in a warm place for a few days. This gives an excellent stain.

Boil the veneers for a few hours in the first stain of salammoniac and steel filings and let them remain for three days. Then place them in the second stain and proceed in the same manner as with the first. In case the veneers should not be entirely colored through, repeat the operation.

Stains for Floors.

Boil 25 parts of fustic and 12½ parts of Brazil wood with 1,000 parts of soapboiler's lye to which has been added 12½ parts of potash. When the liquid is boiled down to 700 or 800 parts, add 3½ parts of annota and 75 parts of wax, and when this has melted, stir the compound until it is cold. It is of a brown-red color and the above quantity suffices to keep a floor in good

condition for a year by applying it once a week and rubbing it on with a brush.

Staining Wood for Veneers, Mosaics, Etc.

Treat the wood for 24 hours with a 10% caustic soda lye. Then boil it therein for half an hour and wash it to remove the alkali. This prepares the wood for the reception of the color. Dry the wood with filtering paper and press it to preserve the shape. Then immerse it for 24 hours in a dye bath consisting of $\frac{1}{3}$ dye wood and $\frac{2}{3}$ liquid; turn it occasionally and finally throw it in a bath of 1 part of sulphate of iron to 3 parts of water and the result will be a beautiful black.

Yellow.—This is obtained with 1 part of picric acid dissolved in 60 parts of water.

Various rose-colored tints are obtained by adding a little caustic soda to coralline.

Red Stain.—Immerse the wood in a solution of $3\frac{1}{2}$ parts of Marseilles soap in 100 parts of water and then apply aniline red sufficiently diluted to give the desired tint.

Violet.—Treat the wood in a bath consisting of $12\frac{1}{2}$ parts of olive oil, a like quantity of calcined soda and 125 parts of boiling water. Then strain with aniline red to which tin salt has been added.

Blue.—Blue is produced in the same manner, except that aniline blue is used as a stain.

Green.—Mordant the wood first with a solution of aluminum acetate of 1 Beaume and then place in a

decoction of Persian berries and indigo carmine. Quercitron may also be used in place of Persian berries.

Bright Red.—Boil for three hours, 6½ parts of cochineal, ground very fine, in 100 parts of water and paint with the solution. When dry, apply a coat of a solution of 3½ parts of tin salt and 1½ parts of tartaric acid in 100 parts of water.

Brown in various tints is produced by mordanting the wood with potassium bichromate and applying later on decoctions of fustic, logwood or Brazil wood.

Another Method of Staining Wood Rose-Color by Chemical Precipitation.

Wood and also vegetable ivory can be colored rose-red without much difficulty by chemical precipitation. The resulting color is very brilliant and uniform.

First Bath.—This consists of 8 parts of potassium iodide to 100 parts of water.

Second Bath.—Two and a half parts of corrosive sublimate to 100 parts of water.

Immerse the wood for a few hours in the first bath. Then place it in the second in which it will acquire a beautiful rose-red color. The wood after drying is varnished. Both baths can be repeatedly used without renewing them.

ETCHING.

Processes of Etching Various Materials.

The following is a simple description of etching: For copper plates two preparations are used:

No. 1.—The mordant is composed of 100 grams of hydrochloric acid, 20 grams of chlorate of potash and 880 grams of water. The water is to be warmed and the chlorate of potash perfectly dissolved in it first; then the acid is added. The common muriatic acid of commerce must not be used, as it gives off intolerable fumes and is of a deep yellow color. The proper form of acid for etching does not fume, and has a very slight odor when mixed with water.

No. 2.—The ground for the copper plate consists of a solution of yellow beeswax in turpentine, decanted until no sediment remains. The solution should be clear and of a bright yellow color. Add one-sixth of its volume of Japan varnish.

To prepare the plate, clean the surface with engraver's emery paper, then pour a small quantity of the mordant into a shallow porcelain dish, such as photographers use, and put the plate in the bath, leaving it until the surface darkens all over. If any spots remain bright, that is a sign that the plate is greasy, in which case the grease must be removed. Then, when the plate is uni-

formly dark, wash and dry and pour on it a little of the ground so that it covers the surface all over. Let it dry for twelve hours, then apply a second coat of ground, and, without waiting for it to dry, smoke the surface with twisted tapers, holding the plate upside down. Let it dry and the plate will be ready for etching on.

Etching needles can be made of ordinary needles with points of different sharpness set in wooden handles. A more satisfactory kind, however, consists of a bar of steel about the thickness of one's little finger in the middle, tapering to a point at each end. These needles are more easy to work with, as the weight of the needle or rather bar, is enough to penetrate the wax coating on the plate, and the hand is left at liberty to draw freely. The needle can be sharpened on a stone. Now proceed to draw on the plate, taking care that the needle goes through the wax and touches the plate. Take care also that your nail does not remove the ground or there will be a line where you do not want one. It is a good plan to have a piece of board with a hollow about $\frac{1}{4}$ inch deep sunk in it, of slightly larger dimensions than the copper. Place the plate in this and have a flat piece of wood like a drawing ruler, which you can place across the hollow so that you can etch any part of the plate without fear of damaging it. Draw all the darkest lines first, then immerse the plate in the bath containing the mordant for three hours. Take it out, dry it with blotting-paper, taking care not to push the wax back into the lines you have drawn. Draw the next darkest lines, put the plate in the bath for one and a half hours, draw again, put it in the bath for three-

quarters of an hour, dry again and draw the lightest lines and put it in the bath for three-quarters of an hour. The lines will have then been bitten for six hours, four and a half hours, one and a half hours, and three-quarters of an hour, according to the darkness you wish to produce. Six hours is about the average time for this biting solution, but it requires a longer time in winter and shorter in summer. The ground must now be removed with petroleum and a proof of the plate taken to see if there is anything further required.

The etching is much improved by being touched up with a sharp knife, filling up gaps you may have left and making the shade blend together. This is done without acid, of course, is more in the style of engraving and is termed dry point. Unless you have some experience in copper-plate printing, send the plate to a lithographer, as it will be a long time before you can print properly.

Alabaster, to Etch.

Use a ground of white wax and oil of turpentine, half thickened with very finely powdered white lead, and etch with very dilute acetic or hydrochloric acid.

Etching on Brass.

No. 1.—Sixteen parts of nitric acid, add to 160 parts of water, dissolve 6 parts of potassium chlorate in 100 parts of water. Mix the two solutions.

No. 2.—For surface printing on brass in the lithographic manner: 8 parts of gum arabic, 2 parts of nutgalls, 1 part of nitric acid, 4 parts of phosphoric acid and 30 parts of water.

Etching on Bronze.

For etching on bronze, the following is very good: 100 parts of pure nitric acid at 40 Beaume, 5 parts of muriatic acid at 20 Beaume.

Etching on Copper.

No. 1.—Nitric acid, 20 Beaume, mixed with an equal amount of water. Add pieces of scrap copper.

No. 2.—One part of nitric acid, 2 parts of potassium bichromate in saturated solution and 5 parts of water.

No. 3.—Ten parts of hydrochloric acid and 70 parts of water. Then add boiling solution of potassium chlorate; dilute.

No. 4.—Relief Etching.—One oz. of nitrous acid at 39 Beaume, 1 dram of silver acetate, 8 oz. of hydrated nitric ether. To prepare nitric ether, mix 1 oz. of alcohol with 1 oz. of nitric acid and stop reaction by adding more water.

No. 5.—Tint Etching.—Two parts of bay salt, 1 part of ammonium chloride, 1 part of verdigris. Grind up with old honey syrup.

No. 6.—Fielding.—One part of nitrous acid and 5 parts of water. Use for aqua tints.

No. 7.—Eight parts of strong vinegar, 4 parts of verdigris, 4 parts of ammonium chloride, 4 parts of salts, 1 part of alum and 16 parts of water.

Etching Brass Signs.

Paint the sign with asphaltum varnish, leaving the parts to be etched unpainted. Raise a border around the

outside, made of beeswax or asphaltum, to hold the acid. Use acid diluted with 5 times the quantity of water. Pour the dilute acid on to the sign about ¼ inch deep. When the letters are cut deep enough, which must be found by trial, the acid may be poured off and the plate cleaned by heating and wiping and finally with turpentine.

Etching on Cutlery.

For etching on cutlery, a ground wax is required, composed of equal parts of asphaltum, Burgundy pitch and beeswax melted together and well incorporated. In applying it use a dabber or ball of cotton covered with silk. Warm the pieces of cutlery so that a stick of the wax will readily melt on touching it. Smear a small quantity of the wax on the blade or article and dab it evenly all over the surface. When cold, scratch the required design on the surface and touch the parts with acid (1 part of nitric acid and 4 to 6 parts of water), using a camel's-hair brush to cover the surface and bring the acid into contact with all the lines. In a few minutes the biting is done. Dip in hot water to wash off the acid and the surface may be cleaned by wiping with benzine.

No. 2.—Another way is to make a varnish of asphaltum and turpentine with a few drops of linseed oil to make it tacky. Have a rubber stamp prepared of the required pattern, with a border, so as to stop off around the design. Stamp the goods and with some of the varnish thinned down with turpentine and a brush, stop off the surrounding parts or surround the design with a small rim of beeswax and apply the acid as above.

No. 3.—For etching brands and marks on polished steel surfaces, such as saws, knife-blades and tools, where there are many pieces to be done alike, procure a rubber stamp with the required design made so that the letters and figure that are to be bitten by the acid shall be depressed in the stamp. Have a plain border around the design, large enough to allow a little border of common putty to be laid around the edge of the stamped design to receive the acid. For ink, use resin, lard oil, turpentine and lamp-black. To 4 oz. of resin put 1 teaspoonful of lard oil, melt and stir in a tablespoonful of lamp-black, thoroughly mix and add enough turpentine to make it of the consistency of printer's ink when cold. Use on the stamp in the same manner as when stamping with ink. When the plate is stamped, place a little border of common putty around and on the edge of the stamped ground. Then pour within the border enough acid mixture to cover the figure, and let it stand a few minutes, according to the depth required. Then pour off the acid. Rinse the surface with clean water, take off the putty border and clean off the ink with turpentine. Use care not to spill the acid over the polished part of the article. For the acid use 1 part of nitric acid, 1 part of hydrochloric acid and 10 parts of water by measure. If the effervescence seems too active, add more water.

Liquid for Etching on Glass.

No. 1.—This preparation may be made by mixing sulphate of barium and fluoride of ammonium in the proportion of 3 parts of the former to 1 part of the

latter with sufficient sulphuric acid to decompose the ammonium and bring the mixture to the consistency of thick milk. The mixture should be made in a receptacle of lead and kept in a bottle of the same metal or else in one of guttapercha, as glass bottles would be eaten into holes. Fluoric acid usually etches smooth, while other fluoric preparations yield a matt surface. The most beautiful ornamentation is obtained when certain parts of the glass surface are rendered matt by means of fluoride of ammonium which has been slightly acidified with acetic acid. The matt appearance is not always the same with different kinds of glass but varies much in beauty. This effect is governed by the composition of the glass, lead glasses being easily acted upon and furnishing a very fine matt surface.

Where it is desired to have the surface of the glass not altogether matt, but shining like ice, as in the case of window glass, this may be obtained by placing the glass plate in a perfectly horizontal position and covering it with fine groats. Then very dilute fluoric acid is poured upon it. The groats act as a shield and produce upon the glass raised points.

Etching Photographs on Glass.

There are several means of doing this. A good result may be secured by covering the surface with a solution of gum made sensitive with bichromate of potash, and printing the same under a negative. After the image is thus produced it is dusted over with minium or red lead and the red picture thus obtained is fixed and burnt in in the usual way. The easily soluble red

glass so obtained is treated with strong sulphuric acid, when a white matt design is produced and the picture appears by transmitted light as a positive.

Etching Films for Tracing With a Needle.

There are many purposes for which an opaque film capable of being etched with a sharp point might be useful. Such a film can be obtained by use of the following formula: ½ oz. of negative collodion, 6 drachms of ether, 6 drachms of alcohol, 30 grains of shellac, 2 grains of aurine, 30 drops of Jackson's mauve dye and 30 drops of water.

Grounds for Etching.

No. 1.
30 oz. of white wax,
30 oz. of mastic resin,
15 oz. of asphaltum.

No. 2.
30 oz. of white wax,
15 oz. of mastic resin,
15 oz. of asphaltum.

No. 3.
6 oz. of white wax,
3 oz. of mastic resin,
6 oz. of asphaltum.

No. 4.
3 oz. of white wax,
1 oz. of black pitch,
4 oz. of asphaltum,
1 oz. of resin.

No. 5.

2 oz. of white wax,
½ oz. of black pitch,
½ oz. of Burgundy pitch.

Melt together, and add by degrees 2 oz. of asphaltum and boil till a drop taken out on a plate will break when cold by being bent double two or three times. Pour into warm water and make into small balls.

No. 6.

4 oz. of soft linseed oil,
½ oz. of gum benzoin,
½ oz. of white wax.

Boil down to two-thirds.

To Etch on Ivory.

Use dilute sulphuric acid and hydrochloric acid mixed.

To Etch on Silver.

Proceed as for copper or brass, but great care must be used in preparing a proper ground and in stopping out.

To Mark Tools With a Name.

Coat the surface of the tool with a layer of wax or hard tallow by heating the tool, applying the wax and allowing the tool to cool. When the wax is hard write the name in with a pointed instrument so that each stroke penetrates to the surface of the steel. Then pour some nitric acid over the waxed surface, let it stand a short time, and after washing off the acid with

water, heat the metal until the wax melts and then wipe it dry. Then the name will appear engraven in the steel.

To Etch on Steel.

No. 1.

2 oz. of sulphate of copper,
½ oz. of alum,
½ oz. of salt,

mixed with

5 oz. of vinegar,
49 drops of nitric acid.

This preparation is used for frosting the steel.

No. 2.

4 oz. of glacial acetic acid,
1 oz. of absolute alcohol,
1 oz. of nitric acid (sp. gr. 1.280).

Allow the acid and alcohol to remain for half an hour, then add the nitric acid very carefully. Etch from one to fifteen minutes.

No. 3.

3 oz. of alcohol,
5 oz. of water, distilled,
8 oz. of nitric acid,
8 oz. of silver nitrate.

Wash the steel plate with very dilute nitric acid, then apply the solution for three minutes and wash with 6% solution of alcohol. Repeat if required.

No. 4.—For vertical bite.

2 oz. of silver acetate,
125 oz. of water, distilled,
125 oz. of rectified spirits,
65 oz. of nitric acid,
16 oz. of nitric ether.

See No. 4 copper plate etching, above.

No. 5.

4 oz. of iodine,
10 oz. of potassic iodide,
80 oz. of water.

This is very highly recommended.

No. 6.—Use No. 3 copper etching, above.

No. 7.

62 parts of nitric acid,
125 parts of water,
187 parts of alcohol,
8 parts of copper nitrate.

No. 8.—Cover the surface with a fine coat of asphaltum varnish of fine quality, then cut the design through to the surface of the steel and etch with a weak solution of nitric acid in water. Finally wash with hot water and remove the asphaltum with hot turpentine.

No. 9.—For steel.

$1\frac{1}{2}$ oz. of iodine,
$\frac{3}{4}$ drachm of iron filings,
6 oz. of water.

Digest until the iron is dissolved. For fine touches take 6 parts each of verdigris, sea-salt and salammoniac,

Dissolve in 12 parts of vinegar, add 23 parts of water, boil a minute and allow to cool.

No. 10.—Clean the steel and cover evenly with wax; cut the lines with a steel point through the wax and pour on the following etching fluid:

4 oz. of pyroligneous acid,
1 oz. of alcohol,
1 oz. of nitric acid, by measure.

Or else use:

1 oz. of iodine,
4 oz. of water,
½ drachm of iron filings.

The fluid is removed as soon as the metal is sufficiently etched.

Zincographic Etching.

No. 1.—The solution most commonly employed for this purpose is as follows: 4 oz. of Aleppo galls are bruised and steeped in 3 quarts of cold water for twenty-four hours. The water and galls are then boiled up together and the decoction strained. The gall water should be about the consistency of cream. One quart of the decoction of galls is added to 3 quarts of gum water and to the mixture is added about 3 oz. of phosphoric acid, which is prepared by placing sticks of phosphorus in a loosely-corked bottle of water so that the ends of the sticks may be uncovered. The oxidation of the phosphorus produces phosphoric acid which dissolves as fast as it is formed. The etching solution should only just mark a piece of zinc,

No. 2.

15 fluid oz. of decoction of gallnuts,
5 fluid oz. of gum water as thick as cream,
3 drachms of phosphoric acid solution.

Boil $1\frac{1}{4}$ oz. of nutgalls, bruised, in 1 pint of water till reduced to one-third. Strain and add 2 drachms of nitric and 4 drops of acetic acids.

No. 3.

40 oz. of gum arabic,
2 oz. of sulphate of copper,
5 oz. of gallic acid,
$\frac{1}{2}$ oz. of nitric acid,
1,000 oz. of water.

No. 4.

100 grains of water,
15 grains of gum arabic,
2 drops of nitric or 4 to 5 drops of hydrochloric acid,
10 drops of solution of gallnuts.

No. 5.—Boil about $1\frac{1}{4}$ oz. of bruised gallnuts in a pint of water till reduced to $\frac{1}{3}$, filter and add 2 drops of nitric acid and 3 to 4 drops of hydrochloric acid. For very fine work, this may be weakened with water. It is applied for about a minute, then washed off and the plate gummed. In biting zinc plates in relief, the acid generally used is nitric of different degrees of strength, according to the nature and state of the plate.

No. 6.—One authority recommends for the first relief etching, 30 to 40 drops of nitric acid to 100 grams

of water, applied for five minutes. For each subsequent etching, 8 to 10 drops of acid are added for each 100 grams of water and the time is increased by degrees from five to fifteen minutes. For the final etching of the broad lights he uses:

4 parts of hydrochloric acid,
1 part of nitric acid,
16 parts of water.

To soften down the ridges between the lines, the plate is inked, dusted as before and etched with diluted nitric acid at 5%, applied for about a minute, and the inking, dusting and etching repeated as often as may be necessary.

No. 7.—According to another authority, the first two bitings are given with 1 part of nitric acid to 40 parts of water, the first biting lasting two minutes, the second four to five minutes. The acid is made stronger for each successive biting.

No. 8.—Another authority gives a first biting with nitric acid at 2% for two or three minutes, adding about the same quantity of acid for five successive bitings, gradually increasing the time. After the first five bitings, the plate is thoroughly cleaned, strongly heated, well inked again with a harder ink, and rebitten with acid as strong as the last used. The operation is repeated for four more bitings, using less heat and biting less and less each time. These bitings are for smoothing off the edges of the lines.

No. 9.—Abney gives the following process: Having made the transfer in the usual way and dusted it with resin, flood the surface of the zinc plate with a 10 grain

solution of sulphate of copper, which precipitates copper on the uncovered parts and forms a copper-zinc couple. It can then be etched with very dilute acid, such as 1 part of hydrochloric acid in 100 to 750 parts of water. This is contained in a rocking trough kept constantly in motion. The first etching takes about twenty minutes. The plate is then washed and inked, dusted and coppered again and then etched with acid twice as strong, the operation being repeated as often as may be necessary.

No. 10.—Deep Etching.—For simple etching on zinc, Hadden recommends 1 part of nitric acid to 3 of water, or

10 parts of hydrochloric acid,
2 parts of chlorate of potash,
88 parts of water.

Dissolve the chlorate of potash in half the water (boiling) and mix the acid with the remainder. The two solutions are added together for use.

No. 11.

2 parts of sulphate of copper,
8 parts of hydrochloric acid.

Frosting of Cutlery, Etc.

This is accomplished by etching the surface with acid. The articles are first heated to about 212° F., then a thin coat of beeswax is melted over the surface. When this is cool the design is scratched through with a needle. The acid is then poured on the design, being prevented from falling off by a little wall of wax built

around the design. Hydrochloric acid does very well for etching. The time required for the operation is best found by a little practice, as the fine lines take more time to etch than is required for the coarse ones. When it is decided that the etching is complete, thoroughly wash away all traces of the acid with clean, cold water and then with a little benzine remove the wax, and polish with clean, dry chamois leather.

Decorative Process of Damaskeening.

The figuration presented by the surface of steel and iron guns, small arms, etc., and also the plain brown or black surface of modern steel guns, is known as "damaskeening," and is produced by treatment with weak acids, which act unequally upon the different parts of the metal under treatment, the harder portions of the metal becoming covered with a thicker film of carbon than the softer portions. The color of these films vary from light brown to black, according to the more or less prolonged treatment with the acids. If the figuration is not sufficiently elaborate, owing to the metal not having sufficient fibre and the fibre being too straight and regular to produce the desired effect, it is customary for the makers of fowling-pieces and other light goods to paint or stencil a pattern on the surface of the metal with the acid, and in this way the figuration can be made as effective as desired. The solutions largely used at many works are as follows:

No. 1.—For steel: 1 oz. of sulphur, 1 oz. of tincture of steel, 1 oz. of nitric acid, ¼ oz. of sulphuric acid, ½

oz. of mercuric chloride, ½ oz. of copper sulphate, 1 oz. of spirit of nitrous ether and 1 quart of water.

No. 2.—For iron: ½ oz. of tincture of iron, 1¼ drachms of nitric acid, 1 drachm of mercuric chloride, ½ drachm of copper sulphate, 6 drachms of spirits of wine and 8 oz. of water.

No. 3.—The solution used at Woolwich and Elswick for steel guns, etc., is 2 oz. of tincture of iron, 1 oz. of nitric acid, 1 oz. of copper sulphate, 1½ oz. of spirits of nitrous ether, 1½ oz. of spirits of wine and 1 gallon of water. This is a much better solution and works remarkably well. It is smeared over the parts, and, when dry, another coat is put on. This will produce a brown color; but if it is not dark enough, the operation must be repeated until the desired tint is obtained. Six coats are sufficient to make the surface black. The acid is then "killed" by washing with soda solution, and the surface rubbed with a hard brush or file card until smooth, after which it is rubbed with oily waste. For iron, there is nothing better than mercuric chloride or antimony chloride, dissolved in water, with a little spirits of wine added to keep it dry.

SILVER.

Pickle for Frosting and Whitening of Silver Articles.

Mix 1 part of sulphuric acid with 4 parts of water. Heat this fluid and steep the article in it until frosted as desired. Wash well, dry with a soft linen cloth or in fine sawdust. For whitening only, use less acid.

An Old Method for Whitening Silver.

Dip the work in a thick solution of borax, then place it in a copper annealing pan, sprinkle it over with charcoal dust and place the pan and its contents upon a clear fire. Heat until redhot, then withdraw and allow to cool. The work is then boiled in dilute sulphuric acid and if the right color is not obtained, the process is repeated one or more times. The lower standards require five or six operations to effect the proper degree of whiteness.

Dip the silver article in a mixture of 4 parts of powdered charcoal and 1 part of nitrate of potash, well mixed with water. The work is then heated until the coating is thoroughly dry, when it is removed from the fire, allowed to cool, and boiled in a solution of bisulphate of potash. After two or three operations, a beautiful dead-white color is the result. It is then washed in soda and water containing a little soap or scratched

and burnished if required bright. The process is completed by drying in warm boxwood sawdust.

Gee's method of whitening silver consists of making the work red hot and boiling in dilute sulphuric acid (1 part of acid to 40 parts of water). The process is repeated, if necessary, until the requisite color is obtained. This method is not suitable for very common work which requires a thin deposit of pure silver by the electrolytic method or by chemical decomposition of certain silver salts applied in the form of a paste, instead of subjecting it to the above whitening process. The articles may also be dipped in solutions containing silver when silver is deposited on their surface. This is termed a simple immersion process.

To Burnish Silver.

Remove all dirt with powdered pumice stone, then brush all parts with strong soap suds, wipe with a linen cloth and burnish. Use soap water as a lubricant.

To Produce a Dead White on Silver Articles.

The article should be heated to a cherry red or dull red, allowed to cool, then placed in a pickle of 2½ parts of sulphuric acid to 50 parts of water. Let it remain in this pickle one to two hours. If the surface is not right, rinse and repeat the operation. When whitened enough, remove from the pickle, rinse well in hot water, and dry in warm boxwood sawdust.

To Frost Polished Silver.

Make a solution of ½ oz. of cyanide of potassium in 5 fluid oz. of water and apply this fluid to the silver with

a brush. Hold the silver with pliers made of lancewood or boxwood. This solution is very poisonous.

To Produce a Pink Tint on Silver.

Dip the cleansed article for a few seconds in a strong hot solution of chloride of copper, then rinse and dry it or dip it in 90% alcohol and ignite the spirit.

To Platinize Silver.

Place some platinum in a small quantity of aqua regia or nitro-hydrochloric acid and keep it in a warm place for a few days, when it will have dissolved. As soon as it has dissolved, evaporate the liquid at a gentle heat until it is as thick as honey, so as to get rid of the excess of the nitric and hydrochloric acids. Add a little warm water and it is ready for use. A dozen drops of this solution go a long way in platinizing silver. The operation is performed in a small glass or beaker covered with a watch-glass to keep in the fumes and placed in a little sand in a saucer to equalize the heat.

To Preserve Silverware.

This may be done by coating the articles (warmed) with a solution of collodion diluted with alcohol.

To Produce a Dead Lustre on Silver.

Mix 7 oz. of white lead and 1 oz. of white litharge with linseed oil varnish. Mix this mass with an oil varnish.

To Make a Silver Tree.

Dissolve 2 drachms of nitrate of silver in 5 fluid oz. of water that has been boiled and filtered and place this

solution in a warm place where it will not be disturbed. Then pour in 1 drachm of mercury (quicksilver). In a short time the silver will be precipitated in the most beautiful arborescent form, resembling real vegetation. The vessel in which the mixture is made should be a clear glass jar fitted with a cover. This silver tree forms an effective ornament.

To Gild the Edges of Books.

To gild the edges, the book should be put into the press straight and on a level with the cheeks of the press between cutting boards, the boards of the book being thrown back. The press should be screwed up very tightly, and any projection of the cutting boards should be taken away with a chisel. If the paper is unsized or at all spongy, the edge should be sized and left to dry. This may be ascertained by wetting a leaf of the paper; if spongy the moisture will sink through as if it were blotting-paper. The edge should be scraped quite flat and perfectly even, care being taken to scrape every part equally, or one part of the edge will be hollow or perhaps one side scraped down, and this will make one square larger than the other. When scraped quite smooth and evenly, a mixture of blacklead and glair water is painted over the edge and with a hard brush it is well brushed until dry.

The gold is now cut on the gold cushion. Lift a leaf out of the book with the gold knife, lay it on the gold cushion and breathe gently on it to the centre of the leaf to lay it flat. It can be cut with ease to any size. The edge is then glaired evenly, and the gold is taken up with a piece of paper previously greased by drawing

it over the head. The edge is then gently laid on the edge which has been glaired. The whole edge or end being done, it is allowed to get perfectly dry, which will occupy two hours.

Before using the burnisher on the gold itself, some gilders lay a piece of fine paper on the gold and gently flatten it with the burnisher. Books are often treated in this manner; they then become dull gilt. When intended to be bright, a waxed cloth should be gently rubbed over the surface two or three times before using the burnisher. The beauty of burnishing depends upon the edge presenting a solid and uniform metallic surface without any marks of the burnisher.

Process of Gilding Books.

White of egg beaten up is the ordinary sticking material used by binders to put the gold leaf on. The leather back of the book is varnished with it and when dry a strip of gold leaf is put on the place where the letters or ornaments are to be placed. The letters used are common printing types; they must be new, however, and not have been used with printing ink. They are heated a little above the boiling point of water, which is easily tried with a wet finger, and then they are pressed on the gold leaf for a few minutes only, when the heating of the albumen or white of egg under it fixes it to the leather of the book. The ornamental figures are commonly made of brass and manufactured for the use of bookbinders. The type is screwed in an appropriate brass or iron holder with a wooden handle. The back of a well-bound book being always round, the

proper way of putting on gilded letters and ornaments requires a certain way of manipulation which it is best to acquire by visiting a few good bookbinders' shops in the city, to see the operation. Use your eyes properly to get all little details. The sides of books being flat, it is best to put the letters and ornaments under a press. The type is put up in a proper form, heated, put under the press, with the varnished side of the book covered with gold leaf on the right place and the press screwed down. Sometimes the binder puts the strips of gold leaf on the face of the type in place of on the book. This is equally good and under certain circumstances preferable.

Gilding on Calf and Sheepskins.

Wet the leather with white of eggs. When dry, rub it with your hand and a little olive oil, then put the gold leaf on and apply the hot iron to it. Whatever the hot iron shall not have touched will go off by brushing.

To Gild the Edges of Cards.

Obtain an extremely thin leaf of gold. Put the cards together so that the edges are perfectly even. Then place in a press with the exposed edge upwards. Coat the edge with a mixture of red chalk and water. The gold is blown out from small books and spread on a leather cushion where it is cut to the proper size by a smooth-edged knife. A camel's-hair pencil is dipped into white of egg mixed with water and with this the partially dry edge is moistened. The gold is then taken up on a tip of a brush and applied to the moistened edge to which it instantly adheres.

When all the four edges have been gilded in this way and allowed to remain a very few minutes, take a burnisher formed of a very smooth piece of hard stone (usually bloodstone) and rub the gold very forcibly, which gives the gold a high degree of polish. To silver edges, take a brush, dip it in a saturated solution of gallic acid and wash the edges, then dip the brush into the solution composed of 2 parts of nitrate of silver to 1,000 parts of distilled water. Keep on alternately with these solutions until the edges assume a brilliant tint. Then wash with distilled water and dry by free air and heat.

A composition for gilding cards consists of 4 parts of Armenian bole and 1 part of candied sugar, ground together with water to a proper consistence, and laid on with the white of an egg. This coating, when nearly dry, is smoothed by the burnisher. It is then slightly dipped in clean water and squeezed in the hand, after which gold leaf is applied.

To Gild Cotton.

Spread a coat of glue-water on the cotton, then dry and afterwards coat with a thick solution of parchment size and again dry thoroughly.

To Gild Ivory.

Put the ivory into a solution of sulphate of iron and then into a solution of nitro-chloride of gold. On heating the ivory the mercury will be driven off and the iron will be gilded.

To Gild Letters on Marble.

First apply a coating of size, then successively apply several coats of size thickened with whiting until a good face is produced. Let each coat dry and rub it down with a fine glass-paper before applying the next. Then go over the marble thinly and evenly with gold size. Apply the gold leaf and polish with an agate burnisher. The gold leaf must be applied several times to give a good effect.

DECORATING CHINA, GLASS, AND METALS.

Process of Common Gilding on China.

The gilding is either done by an adhesive varnish or by heat. This varnish is prepared by dissolving in hot boiled linseed oil an equal weight of either amber or copal resin. This is diluted with a proper quantity of oil of turpentine so as to be applied as thin as possible to the parts to be gilt. Let them stand after varnishing about twenty-four hours, then heat in an oven until so warm as almost to burn the fingers when handled. The heat softens the varnish which is then ready to receive the gold leaf, which may be applied with a brush or tuft of cotton-wool, and the superfluous portions brushed off. Burnish when cold, interposing a piece of paper between the gold and the burnisher. Where "burning in" is practiced, the gold, reduced to powder, is mixed with powdered borax, moistened with a little gum water and applied to the clean surface with a camel's-hair pencil. When quite dry, the article is put into a stove heated to about the temperature of an annealing oven. The gum burns off and the borax, by vitrifying, cements the gold with great firmness to the surface.

Method of Preparing Gold Lustre for China Painting.

Dissolve 1 drachm of gold in $\frac{3}{4}$ oz. of aqua regia (this is a mixture of hydrochloric acid and nitric acid). Or else put this weight of gold in water, add 6 grains of metallic tin and sufficient aqua regia to dissolve it. Pour this with constant stirring into a mixture of $\frac{1}{2}$ drachm of balsam of sulphur, and 20 grains of oil of turpentine. As it stiffens, add $\frac{1}{2}$ drachm more of oil of turpentine and mix. More gold gives a brighter effect; tin inclines it to a violet tinge. Balsam of sulphur is made by boiling together in a covered vessel, 1 part of flowers of sulphur and 4 parts of oil of turpentine until the mass thickens.

Process of Gilding Glass.

No. 1.—Thoroughly clean the glass, then take some very weak isinglass size and while warm, float the glass where you intend the gold to be laid on with a gilder's tip, previously drawing it over the hair of your head to cause the gold to adhere to it. Tilt the glass aside to allow the superfluous size to run away, then let it dry and if it does not look sufficiently solid upon the face, give another layer of gold the same way. Where the black lines are to show, take a piece of pointed firewood, cut it to the width the lines are needed and with a straight edge draw a line with a piece of wood, which if made true and smooth, will take the gold off clean and so square and sharpen up all the edges, lines, etc. When this is done, give a coat of Brunswick black thinned with a little turpentine, and the lines will show

black and it will preserve the gold. Try a small piece first so as to get all in order.

No. 2.—The proper flux is anhydrous borax; the real gilding is effected by the aid of heat. For this purpose a solution of gold in aqua regia (chloride of gold) is precipitated by potash or green vitriol—a finely divided powder (brown) consisting of metallic gold. This is washed, dried and rubbed up with the flux (anhydrous borax). Mix the same with oil of turpentine or gum water and apply with a brush. When heated in the muffle, the volatile oil escapes, the gum is consumed and the borax melts and firmly attaches the gold to the surface of the vessel.

No. 3.—Two grains of isinglass, 2 parts of new rum, 3 parts of water. Put the water and isinglass into a clean pan and let them simmer over the fire for about an hour, add the rum when taken off the fire, then let it cool, clean the glass, pour on the liquid, gild with camel's-hair tip, set the glass upon its edge. The liquid will run from beneath the gold and in less than twenty minutes you will have a burnished plate. When dry, rub lightly with fine cotton and if there are any spots not gilded, gild them. Draw your design on paper, perforate your lines with a needle, put your paper next the gilded side, with the reading the wrong way, dust through the holes with a rag and whiting, lift off the paper and you will find your design marked off. If you wish the letters left clear black, cut around the letters with yellow, paint all over but the letters, wash off the gold with water, then paint all over black. If

you want the letters gold, paint the letters yellow and wash off the surplus gold, then paint all over black.

Embossing and Gilding on Glass.

There are two ways of embossing glass: by means of hydrofluoric acid and by the sandblast. The second method being rather beyond the power of amateurs, I shall not describe it here. In the hydrofluoric acid process, the glass is first coated with some protecting substance and upon this the design is drawn with a sharp instrument so as to expose the glass below. The acid is then applied, when the exposed portion of the glass becomes corroded. The wax can afterwards be removed. In practice the glass should be warmed and coated with molten beeswax, not paraffin—which is too brittle. Superfluous wax should be drawn off so as to leave as thin a coating as possible. Or a composition may be used, formed by melting together 2 parts of beeswax, 2 parts of asphaltum, 1 part of black pitch, and 1 part of Burgundy pitch. Heat them together until a drop placed upon a cool surface gets hard and tough. Whatever the protecting substance used, it should be permitted to set and the design should then be traced with some pointed instrument, care being taken to cut right down to the glass. If the design is complicated, it would be found better to trace it first on paper and then to go over the lines with a pricker. The paper can then be placed upon the wax and some dark-colored powder dusted upon the holes. On removing the paper, the outline of the design will be found marked on the surface of the wax. It will then be easy to cut away

the wax at the desired places. A shallow tray of gutta-percha or of sheet lead must then be taken and into it be placed about half an inch of the dilute hydrofluoric acid of commerce. The glass must then be placed wax-side down over the tray and left exposed to the vapor for some time. On removing it, washing with water and cleaning off the wax, the design will be found etched in opaque lines upon a bright ground. If bright upon an opaque ground is required, the waxed glass, instead of being exposed to the vapor of the acid, should be dipped into the acid itself. After the removal of the wax, the surface of the glass should be ground with emery in a very fine powder.

Other processes are to draw the design on the glass with a pencil and Brunswick black, using as a guide a sketch on paper placed beneath the glass. On exposure to the acid vapor, the whole background will be rendered opaque. The Brunswick black can be cleaned off with turpentine, leaving the design in clear glass.

Instead of Brunswick black, an ink may be used, made by dissolving asphaltum in turpentine and thickening with beeswax and resin.

Where it is desired to produce an artistic effect by the introduction of shading, recourse may be had to Gruene's process, wherein the wax or Brunswick black is replaced by substances not altogether impervious to the action of the acid. The design is drawn with oil varnish, greasy printing inks or some such substance (using a good protector for the high lights and a bad protector for the deep shades), and is then dusted over with finely-powdered metal, copal, etc. When dry, the

glass is dipped into hydrofluoric acid and afterwards washed. If care is taken in the selection of the protecting materials, it is possible for an artistic workman to obtain very striking results.

Gilding on glass may be done with bronze powder or gold leaf.

If the powder is to be used, the design should be traced on the wrong side of the glass with japan gold size, thinly laid on, and which is afterwards dusted over with bronze powder. When dry, a coat of varnish is laid on. In tracing the design, it must not be forgotten that the wrong side of the glass is being worked at, and that when viewed from the front everything will appear twisted around—the right being to the left, and the left to the right. To gild with leaf, the glass must be carefully cleaned and laid upon the design. Then a solution of isinglass is put on by the aid of a flat camel's-hair brush. While still wet, gold leaf is laid on with a gilder's tip (for the sake of economy, adhering to the design as near as possible). When quite dry, the design, the outline of which has been pricked out as before described, is taken and placed upon the gold. Dark-colored powder is then sprinkled on as before. The paper is next removed and the outline carefully gone over with Brunswick black. The superfluous gold is cleaned away by the aid of a sharp, narrow chisel. The size is made by dissolving $\frac{1}{4}$ oz. of isinglass in a sufficiency of water, adding $\frac{1}{4}$ pint of rectified spirits and making up to $\frac{1}{2}$ pint of water.

A somewhat simpler process of gilding glass is the following: Dissolve a piece of gelatine, the size of a

crown piece or a dollar, in ½ pint of very hot water. When cooled, apply this size with a flat camel's-hair brush two to three inches wide, to the glass, previously freed from all traces of grease by washing with alcohol. Apply the gold leaf, cut to the size of letters desired, with a gilder's brush, rubbing the brush on the hair while the size is wet. In presenting the gold leaf to the sized surface, do not touch the glass with the brush or gold—bring the gold leaf within ½ inch of the surface, when it will be found that the leaf leaves the brush and attaches itself to the sized surface (owing to the electrical condition of the brush). Spread the leaf evenly, give it a second coating of the size, outline with asphaltum varnish and fill up the letters with the same. When all is dry, rub off the superfluous gold with cotton-wool.

To Dissolve Gold for Gilding on China Which Has to Be "Fired."

Rub up in a mortar some gold leaf and honey until reduced very fine. Then dissolve the honey with hot water and mix with a little gum water for use, or else dissolve gold in hot aqua regia, evaporate to dryness in a porcelain dish and dissolve in ether for use.

To Gild on Granite.

Apply a coat of size and then two or three coats of size and finely-powdered whiting. Let each coat dry and rub down with fine glass paper before the next is applied, then go over it thinly and evenly with gold size and apply the gold leaf.

To Prepare Powdered Gold.

This is called "divided gold," "gilding powder," "gold bronze," "gold color," "auri pulvis," etc. Make an amalgam by mixing 1 part of gold and 7 parts of mercury and expose it to heat until the mercury is volatilized (or the mercury may be dissolved out with hot nitric acid). In either case, the residuum is to be powdered, washed and dried. If the quantity of the amalgam operated on is considerable, the process should be so conducted as to save the mercury.

To Gild Iron.

Rub the surface of the iron with sodium amalgam, then apply a strong solution of chloride of gold. On heating, mercury will be driven off and the iron will be gilded.

To Gild Metals with Gold Leaf.

Articles of steel are heated until they acquire a bluish color, and iron or copper are heated to the same degree. The first coating of gold leaf is now applied. It must be gently pressed down with a burnisher and again exposed to gentle heat. The second leaf is then applied in the same way, followed by a third and so on, or two leaves may be applied instead of one, but the last leaf should be burnished down while the article is cold.

To Burnish Gold Leaf.

The burnishers used by the frame-makers are either of flint or agate, generally the former. They are made

of various sizes and shapes to suit the work. These are passed lightly over the gilded and dry work. Frame work requires much practical dry work until properly burnished. It is then usually given a thin coat of very weak size. It requires experience to do the work properly.

To Make Silver Leaf Look Like Gold.

The solution employed is a lacquer made by dissolving fine pale shellac in alcohol and coloring with turmeric and dragon's blood.

To Give a Gold Color to Etruscan Ware.

Dissolve in sufficient water, 1 oz. of alum, 1 oz. of fine table salt and 2 oz. of nitrate of potash. Then add sufficient hydrochloric acid to produce the color desired. After coloring, wash in soft water, then in alcohol and dry in clean sawdust.

Method of Brightening or Coloring Inferior Qualities of Gold.

This operation consists of imparting a color to gold articles after every other process has been completed. Its object is to give to alloyed gold all the appearance of fine gold itself, by dissolving out the base metal from the surface of the articles and leaving a facing of a deep, rich color. Two distinct modes of coloring are adopted by jewelers and are termed respectively dry coloring and wet coloring. The latter is most frequently practiced, as the former cannot well be gold inferior to 18 karat quality.

Wet Coloring.

The ingredients of the mixture employed in this process have a powerful solvent action on the metal with which the gold is alloyed and a weaker action on the gold itself, so that the article loses weight in direct ratio to the length it is submitted to the coloring process and this loss is greater as the gold is lower in quality. Gee states that the coloring is hastened and the loss in weight reduced to a minimum by using old coloring liquid, and he assumes that the dissolved gold is to some extent deposited again on the article, because the loss in weight of some common qualities of gold was found to be very little and the amount of gold recovered from the spent coloring liquid very small indeed. This statement is in accord with the well-known fact that in any liquid in which a metal, say copper, is electro-positive to the metal in solution, say gold, the latter is deposited on the former. Many different mixtures are used for coloring gold, some of which will be afterwards given in tabular form. The following has been supplied by an experienced jeweler, and he has found it to be effective:

12 oz. of potassium nitrate,
6 oz. of common salt,
3 oz. of hydrochloric acid.

The nitrate and salt are pounded to a fine powder and placed in a previously warmed crucible about 8 inches by 7, then stirred with a wooden spoon for a minute or two. The acid is then added with about 1 oz. of boiling water and the mass constantly stirred until

it boils up to the top of the pot. The work, which has been previously cleaned in hot potash or soda solution, is then suspended in the coloring liquid by means of a silver or platinum wire for about one minute, then well swilled in boiling water. A little more water is added to the color pot and when the liquid boils up the work is again immersed for another minute and swilled in boiling water as before. This operation of dipping and swilling is repeated several times, the coloring liquid being weakened by adding water before each immersion until the desired appearance is obtained. The work is finally washed in hot water and dried in boxwood sawdust. The whole process takes five to seven minutes.

The colored work is next scratch-brushed on a lathe with a revolving brush made of very fine brass wire and having stale beer dropping on it. If the coloring has been properly conducted a beautiful rich and dead color will be produced.

Dry Coloring.

This term is applied to the coloring process when no liquids are used as constituents of the liquid. The ingredients used are:

8 oz. of potassium nitrate,
4 oz. of common salt,
3 oz. of alum.

These substances are ground to a fine powder, well mixed and placed in a previously heated blacklead color pot of the same dimensions as that described for use in wet coloring, but the same pot must not be employed for dry coloring as has been used for the wet process. It is

well to get the pot nearly redhot before placing the color in it. The mixture must then be constantly stirred with an iron rod. It will first boil up as a greenish liquid, then solidify and afterward boil up a second time and become thoroughly fused, having a brownish-yellow color. At this stage the work, which has been previously annealed and dipped in dilute aqua-fortis, is dipped in the color, being suspended on a platinum wire, the latter being preferred, and kept in motion for about a minute and a half, then immersed in boiling water containing a little aqua-fortis. The immersion and swilling are again repeated and the articles will possess a beautiful color. They are then washed in hot water containing a little potash, and finally dried in warm boxwood sawdust.

In dry coloring the work should be as highly polished as possible previous to the coloring. The brighter it is the better will be the final color. The time given above is only given as a general guide. Some work will color quicker than others and the time can only be arrived at by experience. The following mixtures have been recommended for coloring:

Dry Process.

No. 1.

8 oz. of nitrate of potash.
4 oz. of common salt,
4 oz. of alum.

No. 2.

4 oz. of salammoniac,
4 oz. of nitrate of potash,
4 oz. of borax.

Wet Process.

Nitrate of potash	8	14	15	14
Common salt	4	7	7	7
Alum	4	7	7	—
Hydrochloric acid	—	2	1	5

Use water in each case.

The following is a useful mixture for removing tarnish from colored gold articles which have been kept in stock for some time:

1 oz. of bicarbonate of soda,
1 oz. of chloride of lime,
1 oz. of common salt,
16 oz. of water.

Well mix the above ingredients and apply with a soft brush.

To Impart a Blue or Gray Finish on Optical Instruments.

The steel-gray or bluish tint upon instruments is made by dipping or washing with chloride of platinum solution, which is made by dissolving platinum in 2 parts of hydrochloric acid and 1 part of nitric acid, mixed (this forms aqua regia), with as much platinum as the quantity of acid you may wish to prepare will take up. Use platinum foil, put the whole in a glass bottle with a wide mouth, cover loosely and place in a warm sand bath or any place where it will be as hot as boiling water for a few days, when it will be ready for use. As soon as the proper color is produced, wash the instrument in water. If the solution is not saturated, the brass will turn brown and rough.

Methods of Gilding by Amalgam.

Preparation of the Amalgam.—To prepare the amalgam of gold for the purpose of mercury gilding, a weighed quantity of fine or standard gold is first put in a crucible and heated to dull redness. The requisite quantity of mercury, 8 parts to 1 part of gold, is now added, and the mixture is stirred with a slightly crooked iron rod, the heat being kept up until the gold is entirely dissolved by the mercury. Pour the amalgam into a small dish about 3 parts filled with water and work about with the fingers under the water to squeeze out as much of the excess of mercury as possible. To facilitate this, the dish is slightly inclined to allow the superfluous mercury to flow from the mass, which soon acquires a pasty condition capable of receiving the impression of the fingers. Afterward squeeze the amalgam in a chamois leather bag, by which a further quantity of mercury is liberated, the amalgam which remains after this final treatment consisting of about 33 parts of mercury and 57 parts of gold in 100 parts. The mercury which is pressed through the bag contains a good deal of gold and is employed in preparing fresh batches of amalgam. It is important that the mercury employed should be pure.

The Mercurial Solution.—To apply the amalgam, a solution of nitrate of mercury is employed, which is prepared by dissolving in a glass flask 100 parts of mercury in 110 parts of nitric acid of 1.33 specific gravity, gentle heat being employed to asist the chemical action. The red fumes which are given off must

be allowed to escape into the chimney, since they are injurious when inhaled. When the mercury is all dissolved, the solution is to be diluted with about 25 times its weight of water and bottled for use.

Method of Applying the Amalgam.—The pasty amalgam is spread with the blade of a knife upon a hard, flat stone; the article, after being well cleaned and scratch-brushed, is treated in the following manner: Take a piece of small scratch-brush, formed of stout brass wire, dip in the solution of nitrate of mercury, then draw over the amalgam, pass the brush carefully over the surface to be gilded, repeatedly dipping the brush in the mercurial solution and drawing it over the amalgam until the entire surface is uniformly and sufficiently coated. Then rinse the article well and dry. The next operation is the evaporation of the mercury. For this purpose a charcoal fire resting upon a cast-iron plate has been generally adopted, a simple hood of sheet iron being the only means of protection from the injurious effects of the mercurial vapor. When the amalgamated article is rinsed and dried, it is exposed to the glowing charcoal, turned about and heated by degrees to the proper point. It is then withdrawn from the fire by means of long pincers or tongs. The article is then taken in the left hand (which should be protected with a leather glove), turned over the fire in every direction, and, while the mercury is volatilizing, the article should be struck with a long-haired brush to equalize the amalgam coating and force it upon such parts as may appear to require it. When the mercury has become entirely volatilized, the gilding has a dull

greenish-yellow color. The article is then well scratch-brushed, when it has a pale greenish color. Heat it again to expel any remaining mercury and it acquires the orange color of fine gold. If required to be bright, it is burnished in the ordinary way.

Gilding Liquid.

This liquid is used to impart a rich color to inferior gilt articles, such as trinkets, etc.: Dissolve in 5 fluid oz. of water:

1 oz. of chloride of sodium,
2 oz. of nitrate of potash,
1 oz. of alum.

The application of this liquid should not be too long continued, as it dissolves a small proportion of the gold. For common purposes, it is best diluted with water.

Mixtures for Gilding Metals.

The metal employed for gilding is usually brass or a mixture of brass and copper. The following alloys have been recommended:

No. 1.—Copper, 6 parts; brass, 1 part.

No. 2.—Copper, 4 parts; Bristol brass, 1 part.

No. 3.—Copper, 15 parts; old Bristol brass, 3 parts; tin, 14 parts.

Mixtures Employed in Gilding by Fire or by the Wet Process.

Red ormolu:

30 parts of potash alum,
30 parts of nitrate of potash,
8 parts of sulphate of zinc,

3 parts of common salt,
28 parts of red ochre,
1 part of sulphate of iron.

Add to the mixture a small portion of annatto, madder, cochineal, or other coloring matter, ground in water or weak vinegar.

Yellow ormolu:

17 parts of red ochre,
50 parts of potash alum,
10 parts of sulphate of zinc,
3 parts of common salt,
20 parts of nitrate of potash.

Dead Lustre for Jewelry.—Take equal parts of sulphate of zinc, sulphate of iron, potash, alum and nitrate of potash. Melt them in their water of crystallization.

Hard dead lustre for clocks:

5 parts of water,
37 parts of nitrate of potash,
42 parts of potash alum,
12 parts of common salt,
4 parts of sulphate of calcium,
4 parts of pulverized glass.

Mix the whole and grind together.

Soft dead lustre for smooth surfaces and figures:

5 parts of water,
46 parts of nitrate of potash,
46 parts of potash alum,
3 parts of common salt.

Follow the same treatment as in the preceding mixture.

Green for red lustre:

65 parts of bitartrate of potash,
25 parts of common salt,
10 parts of acetate of copper.

Grind the whole well together.

Wax for gilding:

25 parts of oil,
25 parts of yellow wax,
13 parts of acetate of copper,
37 parts of red ochre.

Melt the whole together and stir until cold.

Gold Leaves, to Apply to Paper.

Glair, which is pure albumen, is sometimes used. It is made by shaking up the white of an egg with a few drops of ammonia and drawing off the clear liquid which has subsided on standing. This is painted on the lines and by slight heat, as of a hot iron, the leaf adheres. Gold size is used on stiff paper or thick gum arabic water may be used. The illuminators of to-day cannot get as good results as did the workers of the middle ages. The old gilding is never equalled now.

Methods of Oil Gilding.

This species of gilding may be divided into several operations.

No. 1.—The surface is prepared by a coating of white lead in drying oil.

No. 2.—Another coating is given. This is made with calcined white lead ground in linseed oil and turpentine. Three or four coats of this mixture are often

given, observing to carefully smooth off each coat with pumice or shave grass before the application of the following ones.

No. 3.—The gold paint or color is next applied. It is usually very adhesive gold size or the bottom of the pot or dish in which painters wash their brushes. For this purpose it is thoroughly ground and strained.

No. 4.—When the gold color begins to partially dry and is sufficiently tenacious, the gold leaf is applied and pressed on with a wad of cotton-wool or a soft brush.

Formulæ for Lacquers for Metals.

Lacquers differ from varnishes in the matter of the solid constituent, which in the case of lacquers is shellac, whereas in varnishes it is resins of various kinds; moreover, the fluid solvent is always alcohol, or methylated spirit, but in varnishes it may be either spirit, oil or turpentine. A solution of shellac in spirit forms a fluid which dries hard quickly and with a gloss and can be heated or baked on a surface (japan). The following recipes for lacquers are typical of most of them that are used for metals.

The Preliminary Operations in Lacquering Brass.

Be sure there is no oil or grease on the brass. Do not touch the work with the fingers, but hold it with tongs or by a tapered stick in some of the holes that may be in the piece of work. Always handle with a piece of clean cloth. Heat the work so hot that the brush will smoke when applied, but avoid overheating, as it burns the lacquer. It is well to fasten a small wire across the lacquer cup from side to side to scrape away any superfluous lacquer. The brush should have the ends of the hairs all exactly equal and even. If not so, trim the ends with sharp scissors. Scrape the brush as dry as possible on the wire, making a flat, smooth point at the same time.

Use the very tip of the brush to lacquer with and carry it with a steady hand.

Put on at least two coats. It is well (in order to make a durable coating) to blaze off each coat with a spirit lamp or Bunsen burner, taking care not to overheat and burn the lacquer. If the lacquer is too thick, it will look gummy on the work. If too thin, it will show prismatic colors. In the first case, add a little alcohol; in the latter case, set the cup on the stove and evaporate some of the lacquer to make it thicker.

A good deal of cheap work, like lamp-burners, is dipped. Thus: Use a bath of nitric and sulphuric acids, equal parts, dip the work, hung on wire into the acid for a moment, remove, rinse in cold water thoroughly, dip in hot water, remove, put into alcohol, rinse round, shaking vigorously on removing to throw off extra lacquer and lay on a warm metal plate till dry; let cool and it is done. Avoid handling lacquered work until it is cold.

Decorating Metals and Other Materials by Japanning.

When finished wood, papier-mâché, compositions or materials are varnished in the usual way and dried in the air, the drying is in most cases imperfect, and the coating more or less uneven. If the surface thus varnished is heated for some time to a temperature of from 250 to 300° F. or higher, it is found that the whole of the solvent or vehicle of the gums or resins is driven off in the varnish and the gummy residue becomes liquefied or semi-liquefied, in which state it adapts itself to all inequalities, and, if the coating is thick enough, pre-

sents a uniform glossy surface, which it retains on cooling. This process of drying out and fusion secures a firm contact and adhesion of the gums or resins to the surface of the substance varnished, and greatly increases the density of the coating, which enables it to resist wear and retain its gloss longer.

This process of hardening and varnishing lacquered work by the aid of heat constitutes the chief features of the japanner's work. In practice, the work to be japanned is first thoroughly cleansed and dried. If of wood, composition or other porous material, it is given while warm several coats of wood filler or whiting mixed up with a rather thin glue size, and when this is hardened, is rubbed down smooth with pumice stone. It is then ready for the japan ground. Metals as a rule require no special preparation, receiving the ground directly on the clean, dry surface.

In japanning wood and similar substances, they require a much lower degree of heat and usually a longer exposure in the oven than metals; and again, a higher temperature may be advantageously employed, when the japan is dark, than when light-colored grounds are used, so that a definite knowledge of just how much heat can be safely applied and how long an exposure is required with different substances and different grounds can only be acquired by practical experience. Large japanners seldom make their own varnishes, as they can procure them cheaply from the varnish maker. The japanner's oven is usually a room or large box constructed of sheet metal and heated by stove drums or flues, so that the temperature (which is indicated by a

thermometer hung up inside, or with its stove passing through the side wall midway between the top and bottom of the chamber) can be readily regulated by dampers. The ovens are also provided with a chimney to carry off the vapors derived from the flying varnish, a small door through which the work can be entered and removed and wire shelves and hooks for its support in its chamber. The ovens must be kept perfectly dry, free from dust, smoke and moisture. A good, cheap priming varnish for work to be japanned consists of:

2 oz. of pale shellac,
2 oz. of pale resin,
1 pint of rectified spirit.

Two or three coats of this is put on the work in a warm, dry room. A good black ground is prepared by grinding fine ivory black with a sufficient quantity of alcoholic shellac varnish on a stone slab with a muller, until a perfectly smooth black varnish is obtained. If other colors are required the clear varnish is mixed and ground with the proper quantity of suitable pigments in a similar manner.

For red, vermilion or Indian red is used; for green, chrome green; blue, Prussian blue; yellow, chrome yellow, etc. But black is the hue commonly required. The following are good common black grounds:

No. 1.

1 lb. of asphaltum,
1 lb. of balsam of capivi,
q. s. of oil of turpentine.

The asphaltum is melted over a fire and the balsam,

previously heated, is mixed in. The mixture is then removed from the fire and mixed with the turpentine.

No. 2.—Moisten good lampblack with oil of turpentine and grind it very fine with a muller on a stone slab. Then add a sufficient quantity of ordinary copal varnish and rub well together.

No. 3.

3 oz. of asphaltum,
4 qts. of boiled oil,
8 oz. of burnt umber,
q. s. of oil of turpentine.

Melt the asphaltum, stir in the oil, previously heated, then the umber, and when cooling, thin down with oil of turpentine.

No. 4.—An extra fine black is prepared from:

12 oz. of umber,
2 oz. of asphaltum,
½ pint of boiled oil,
2 oz. of resin,
16 oz. of oil of turpentine.

Fuse the gum, resin and asphaltum, add the hot oil, stir well together, and when cooling, add the turpentine.

A white ground is prepared from copal and zinc white or starch.

From one to six or more coats of varnish are applied to the work in japanning, each coat being hardened in the oven before the next is put on. The last coat in colored work is usually of clear varnish without coloring matter, and is, if fine work, finished with rotten

stone and chamois. For ordinary work, the gloss developed in the oven under such conditions is sufficient.

Japan Finishing.

The finishing part of japanning lies in laying on and polishing the outer coats of varnish, which is necessary in all painted or simply ground-colored japan work. When brightness and clearness are wanted, the white kind of varnish is necessary, for seedlac varnish, which is the hardest and most tenacious, imparts a yellow tinge. A mixed varnish is the best for the purpose, that is, for combining hardness and purity. Take, then, 3 oz. of seedlac, picked very carefully from all sticks and dirt, washing it well with cold water, stirring it up, pouring it off and continuing the process until the water runs off perfectly clear. Dry the lac, and then reduce it to powder and put it into a bottle with 1 pint of alcohol, so as to fill about two-thirds of its space. Shake this mixture well and keep the bottle at a gentle heat (being corked) until the lac has dissolved. When this is the case, pour off the clear fluid and strain the remainder through a cloth and put the fluid thus obtained into a well-stoppered bottle for use. The manner of using this seedlac varnish is the same as that before described and a fine polishing varnish is made by mixing this with pure white varnish. The pieces of work to be varnished for finishing should be placed near a stove or in a warm, dry room, and one coat should be perfectly dry before the other is applied. The varnish is applied with proper brushes, beginning at the middle,

passing the strokes to one end and with the other stroke from the middle to the other end. Great skill is required in laying on these coats of varnish. If possible, the brush should never cross or pass twice over in giving one coat.

When one coat is dry, another must be laid over it, and so on successively for a number of coats, so that the coating should be sufficiently thick to stand fully all the polishing, so as not to bare the coloring of the work. When a sufficient number of coats are laid on, the work is fit to be polished, which in common cases is commenced with a rag dipped in finely-powdered rotten stone. Toward the end of the rubbing a little oil should be used along with the powder, and when the work appears fine and glossy, a little oil should be used alone to clean off the powder and give the work a still brighter hue. Pumice ground to a fine powder is used for the first part of the polishing, and the finishing done with whiting. It is always best to dry the varnish of all japan work by heat. For woodwork, heat must be sparingly used, but for metals the varnish should be dried in an oven, also for papier-mâché and leather. The metal will stand the greatest heat and care must be taken not to darken by too high a temperature. When gold size is used for gilding for japan work where it is desired not to have the gold shine, the gold size should be used with a little of the spirits of turpentine and a little oil; but when a considerable degree of lustre is wanted without burnishing and the preparation necessary for it, a little of the size along with the oil alone should be used.

Grounds for Japanning.

Black, No. 1.—Mix shellac varnish with either ivory or lampblack, but the former is preferable. These may always be laid on with the shellac varnish and have their upper or polishing coats of common seedlac varnish.

No. 2.—A common black japan made by painting a piece of work with drying oil and putting the work into a stove not too hot, but of such a degree as will change the oil black without burning it, gradually raising the heat and keeping it up a long time. This requires no polishing.

No. 3.—Asphaltum, ½ lb., melt, then add hot balsam of capivi, 2 lbs., and when mixed, thin with hot oil of turpentine.

No. 4.—Grind lampblack very smooth on a marble slab with turpentine, then add copal varnish to the consistency desired.

Black.

No. 1.

3 oz. of asphaltum,
4 qts. of boiled oil,
8 oz. of burnt umber.

Mix by heat, and when cooling, thin with turpentine.

No. 2.

12 oz. of umber.
2 oz. of asphaltum,
½ pint of boiled oil,
2 oz. of resin.

When cooling add

16 oz. of oil of turpentine.

Both are used to varnish metals.

Blue.

Blue japan grounds may be formed of bright Prussian blue. The color may be mixed with shellac varnish and brought to a polishing state by five or six coats of seedlac varnish. Whenever a light blue is desired, the purest varnish must always be used.

Green.

A good green may be made by mixing Prussian blue with the chromate of lead or with turmeric, only the two should be ground together, dissolved in alcohol and applied as a ground, then coated with four or five coats of shellac varnish in the manner already described. A very bright green is made by laying on a ground of Dutch metal or leaf of gold and then coating it over with distilled verdigris dissolved in alcohol, then the varnishes on the top. This is a splendid green, brilliant and glowing.

Orange.

Orange grounds may be made with yellow mixed with vermilion or carmine, just as a bright or rather inferior color is wanted. The yellow should be always in quantity to make a full good color and the red added in proportion to the depth of shade. If there is not a good full body of yellow, the yellow will look watery or "bare," as it is technically called.

Purple.

This is made by a mixture of lake and Prussian blue or carmine or (for an inferior color) vermilion, and treated as the foregoing. When the ground is laid on and perfectly dried, a fine coat of pure boiled nut oil then laid on and perfectly dried is a good method to have a japan not liable to crack. But a better plan is to use this oil in the varnish given the first coat, after the ground is laid on, and which should contain much turpentine. In every case where oil is used for any purpose for varnish, it is all the better if turpentine is mixed with it.

Red Japan Ground.

The base of this ground must be made up with madder lake, ground with oil of turpentine. This forms the first ground; when perfectly dry a second coat must be applied, composed of lake and white copal varnish; and the last with a coat composed of a mixture of copal and turpentine varnish mixed up with lake. Vermilion or carmine can also be used for red japan instead of lake.

White Ground.

To form a hard, white ground is no easy matter, as the substances generally used to make the japan hard have a tendency with a number of coats to look dull. One white ground consists of the following composition: Flake white or white lead, washed over and ground up with half of its weight of starch, then dried and mixed with the finest gum, ground up in proportions of 1 oz. to ½ oz. of rectified turpentine, mixed and

ground thoroughly together. This is to be finally laid on the article to be japanned, dried and then varnished with five or six coats of the following: 2 oz. of the finest seedlac to 3 oz. of gum anime, reduced to a fine powder and dissolved in 1 quart of alcohol. The lac must be carefully picked. For a softer varnish than this, a little turpentine should be added and less of the gum.

A very good varnish, which is not brittle, may be made by dissolving gum anime in nut oil, boiling it gently as the gum is added and giving the oil as much as it will take up. The ground of white varnish may of itself be made of this varnish by giving two or three coats of it, but when used it should be diluted with pure turpentine. Although this varnish is not brittle, it is liable to be indented with strokes and will not bear to be polished; but, if well laid on, it will not need to be laid on afterwards. It also takes some time to dry. Heat applied to all oils darkens their color and oil varnishes for white grow very yellow if not exposed to a full, clear light.

Yellow Grounds.

No. 1.—King's yellow may be used and the effect will be heightened by dissolving powdered turmeric root in the spirits of wine, of which the upper or polishing coat is made. The spirits must be drained from the dregs before the seedlac is added to it to form the varnish.

No. 2.—If turmeric be dissolved in the spirits of wine and strained through a cloth and then mixed

with the seedlac varnish, it makes a good yellow japan. Saffron will answer for the same purpose in the same way, but the brightest yellow ground is made by a primary coat of pure chrome yellow and coated successively with the varnish.

No. 3.—"Dutch pink" is used for a kind of cheap yellow japan ground. If a little dragon's blood be added to the varnish for yellow japan, a most rich and beautiful salmon-colored varnish is the result and by these two mixtures all the tones of flesh-colored japans are produced.

Japans With Aniline Colors.

These may be made by using the oil dyes. These dyes stand heat very well, whereas most of the ordinary aniline colors cannot stand heat without fading.

Black Japan for Leather.

Four oz. of burnt umber, 2 oz. of real asphaltum, ½ gallon of boiled oil. Dissolve the asphaltum by heat in a little of the oil, add the burnt umber, ground in oil, and with it, the remainder of the oil; mix, cool and thin with turpentine until it is flexible.

Imitation of Japanning.

The peculiar glossy surface on the so-called japan trays can only be given by practice, but a mere imitation may be effected as follows: Mix ivory black with melted size, apply the mixture quite hot to the box or any other wooden article that it may be desired to treat in this manner. When dry, sandpaper the box, then give another coat of black. When this second coat is

dry, bring to smoothness with sandpaper, at the same time taking care not to remove the stain so that the light wood below is exposed. Now procure 1 lb. of black japan and 1 gill of turpentine; mix enough of the black japan for present use with turpentine, of which only sufficient should be used to make the japan fluid enough to run from the brush. A fine-haired paint brush should be employed. If properly done one coat will be sufficient and the box will look nearly equal to japan goods. Dry the varnished box in a warm room free from dust.

Old Tea-Trays, to Japan.

First clean them thoroughly with soap and water and a little rotten stone, then dry by wiping them and exposing to fire. Now get some good copal varnish, mix with it some bronze powder and apply with a brush to the denuded parts. After which set the tea-tray in an oven at a heat of from 212 to 300° F. until the varnish is dry. Two coats will make it equal to new.

Japan Flow for Tin.

Three quarts of spirits of turpentine, 3 oz. of balsam of tolu, ¾ pint of linseed oil, 3 oz. of acetate of lead, 3 oz. of balsam of fir and 3 lbs. of gum sandarac. Put these materials, except the turpentine, in a suitable vessel. Place over a slow fire at first, then increase the heat until they are melted. When a little cool, stir in the turpentine.

To Produce the Well-Known Tortoise-Shell Japan

This kind of japan is very pretty and comparatively easy to manipulate. The work is first coated with a

japan made by boiling 1 quart of linseed oil with 4 oz. of umber until it becomes thickened. The mixture is then strained and boiled until it becomes of a pitchy consistency. This is then mixed with turpentine to a workable consistence and then applied. When the coat has thoroughly dried, lay a quantity of vermilion spots to represent the clear portion of the shell. The vermilion japan is made by adding vermilion to shellac varnish; it should be laid on thinly and dried. The whole surface is then coated with a thin layer of the above-described brown japan still further diluted with turpentine. A long course of "stoving" will be necessary to thoroughly harden the japanning.

Transparent Japan.

This is used for japanning tin, such as canisters, etc. It is prepared by dissolving 8 oz. of oil of turpentine, 6 oz. of oil of lavender, 1 drachm of camphor and 2 oz. of bruised copal. Sometimes quick-drying copal varnish is used instead of the above compound.

To Renovate Japanese Lacquered Work.

Dissolve 3 oz. of copal and 2 oz. of camphor in 6 oz. of oil of turpentine by gently heating the mixture with the aid of a water bath. Then add 30 fluid oz. of oil of lavender. The work to be renovated should be allowed a few days' rest to become clarified, and then the clear fluid can be poured off from the dregs for use. It is a transparent varnish, practically colorless, and will renovate lacquered work whether of wood or metal.

DECORATING METALS BY OXIDIZING AND PLATINIZING.

To Oxidize With Solution of Platinum.

Dissolve sufficient platinum in aqua regia and carefully evaporate the resulting solution (chloride of platinum) to dryness. The dried mass may then be dissolved in alcohol, ether or water, according to the effect which it is desired to produce, a slightly different effect being produced by each of the solutions. Apply the solution of platinum with a camel's-hair brush and repeat the operation as often as may be necessary to increase the tone. A single application is frequently sufficient. The ethereal or alcoholic solution of platinum must be kept in a well-stoppered bottle and in a cool place. The aqueous solution of platinum should be applied hot.

To Oxidize Copper and Brass.

Immerse the articles in a solution of 2 oz. of nitrate of iron and 2 oz. of hyposulphite of soda to 1 pint of water until the desired shade of oxidation is acquired; then wash and brush.

To Oxidize Silver.

No. 1.—Add .004 to .005 of ammonium sulphide to water at a temperature of 160 to 180° F. When

the articles are dipped into this solution, an iridescent coating of silver sulphide is produced, which after a few seconds turns black if allowed to remain in the liquid. Remove, rinse and burnish when desired.

No. 2.—There are two distinct shades in use, one produced by a chloride and the other by sulphur, which has a bluish-black tint. To produce the former, it is only necessary to wash the article with a solution of salammoniac.

No. 3.—A much more beautiful tint may be obtained by employing a solution composed of equal parts of coppper sulphate and ammonium chloride in vinegar or dilute acetic acid. The fine black tint may be produced by a slightly warm solution of sodium or potassium sulphide.

No. 4.—Five grains of bromide, 5 dwts. of potassium bromide and 10 oz. of water. Boil the silver in this, usually two to five minutes, then polish with rouge.

No. 5.—Dissolve 2 dwts. of sulphate of copper, 1 dwt. of nitrate of potash and 2 dwts. of ammonium chloride in a little acetic acid. Warm the articles and apply the solution with a camel's-hair brush and expose to the fumes of sulphur in a closed box. Parts not to be colored must be coated with wax.

No. 6.—Dip the clean silver article in a solution of 2 drachms of sulphide of potassium (liver of sulphur) to 1 pint of water. Heat this solution to a temperature of 175° F. Immerse for a few seconds only, when the article becomes blue-black. For a velvet-black, dip the article, previous to oxidizing, in a solution of mercurous nitrate and water, then rinse. Then dip in

the sulphide solution as above; next dip in a liquid composed of 10 parts of sulphate of copper (blue vitriol) and 5 parts of salammoniac to 100 parts of vinegar. After oxidation, brush with a scratch-brush very lightly to brighten and variegate the surface.

There are many other methods, among which will be found the following:

(*a*) Exposure to the vapor of chlorine.

(*b*) Use a solution of equal parts of copper sulphate and ammonium chloride dissolved in vinegar.

(*c*) Use potassium sulphide dissolved in warm water.

(*d*) Use sodium sulphide dissolved in warm water.

(*e*) Wash with a solution of ammonium chloride.

Cheap Method of Platinizing Metals.

In this process, the metallic object is covered with a mixture of borate of lead, oxide of copper and spirits of turpentine and submitted to a temperature of from 250 to 330° F. This deposit, on melting, spreads in a uniform layer over the object. Then a second coat is laid on, consisting of borate of lead, oxide of copper and oil of lavender. Next, by means of a brush, the object is covered with a solution of chloride of platinum which is finally evaporated at a temperature of not more than 200° F. The platinum adheres firmly to the surface and exhibits a brilliant aspect. If the deposit be made upon the first coat, the platinum will have a dead appearance. Platinizing in this way, it is stated, costs about one-tenth the price of nickel-plating.

Method of Platinizing Copper.

The appearance of platinum may be given to copper by immersion in a bath composed of 35 fluid oz. of hydrochloric acid, $7\frac{1}{2}$ oz. of arsenic acid and $1\frac{1}{4}$ oz. of acetate of copper. The article must be cleaned before immersion and left in the bath until it has the color of platinum.

Method of Platinizing Silver.

Put some platinum in a small quantity of aqua regia (nitro-muriatic acid) and keep it in a warm place for a few days. It will dissolve. As soon as it has dissolved, evaporate the liquid at a gentle heat until it is as thick as honey, so as to get rid of the excess of the nitric and hydrochloric acids. Add a little water and it is ready for use. A dozen drops of this solution goes a long way in platinizing silver. The operation is performed in a small glass or beaker with a watch-glass to keep in the fumes, and placed in a little warm sand in a saucer to equalize the heat.

METHODS OF POLISHING WOODS, ETC.

French Polishing.

This is the name given to the art of coating wood with a fine, smooth, glossy surface or varnish of shellac and various other gum-resins, which are easily soluble in 90% alcohol, methylated spirit or wood naphtha. A varnish is thus produced; but if it is applied with a brush, as copal, mastic and most other varnishes, the result is a very broken and uneven surface, instead of a smooth and continuous polish. To obtain a good polish with a lac varnish on wood, it is necessary to apply a very small quantity at once and to rub it continuously until it dries; when this process has been carefully and properly gone through, the result is a beautiful and even surface, which is not to be surpassed or even equalled by any other means.

Rubbers.

The small pliable rubbers employed for doing carved framework, etc., are usually made of white wadding; and the large, round ones used for surface work are mostly formed of soft flannel. The latter kind must be firmly made and the more they possess such qualifications as proper size and solidity, the more quickly will they polish extensive surfaces.

Rags.

Fine linen makes the best rubbber coverings, but cheap cotton will answer as well. Both stuffs are preferred after having been used and washed several times. The way to wash them is to boil them first in a strong lye of potash and then in a weak one of soap powder, suffering each boiling to be succeeded by a thorough rinsing in clean water.

Wettings.

Some workmen wet the soles of their rubbers by dipping into a saucer containing the preparation, and others by holding their bottles upside down, allowing the polish to shower through the drilled apertures of the stopples. Care should be taken not to soak the rubber too much by either means, and after wetting and covering the sole it ought always to be pressed forcibly upon the palm of the hand so as to equalize the moisture.

Rubbings.

Invariably on beginning with a newly-wetted rubber, gently and regularly sweep the surface from end to end in the running direction of the fibre three successive times, then rub across the grain with a semi-circular motion until the polishing tool becomes dry. The operation is of course repeated until the whole of the surface of the pores is no longer visible. The work so treated is now to be left in a clean compartment for a period of twelve hours, this being the time required for the absorption of the first body. The sinking

period having expired, the work is smoothed, dusted, etc., and then the polishing of it is recommenced. The first sweepings are similar to those described in the preceding, after which ply the rubber wholly with a rotary movement, leaning lightly on it at first and slightly increasing the necessary pressure towards the drying of it, which is finally accomplished by sweeping once or twice along the grain to remove any marks that have been caused by the cross or round rubbings. Wipe off the dirt after each commencement. Allow every body a proper time to absorb and harden, previous to the reapplication of smoothing stuffs or polishes. Cover your rubber with a clean part of the rag at each wetting. Carefully guard against working your implement too long in one direction and leaning too heavily on it when it is very wet, else you will be apt to produce marks and streaky roughness.

To Remove Rubber Marks.

Rubber marks may be removed by being reversely rubbed with a heavily pressed half-dry rubber. In spiriting, the spiriting spirit should not be used in excess, because it dissolves a portion of the resinous or gummy body and thereby causes dimness instead of brightness. If, however, the spirit be slightly mixed with polish and be sparingly employed, the desired clearness of lustre will make itself apparent. Prior to the application of the spirit cloth, which consists of a few soft rags loosely rolled up in the shape of a large finger rubber and slightly damped with spirit, it is most essential to ply the rubber more quickly and a

little longer than ordinary, for the purpose of removing all signs of moisture and greasiness from the surface of the gloss. Most polishers seem to think that nothing can be more productive of transparent brilliancy and durable hardness at the finish, than the moderate use of spirit that has been somewhat weakened by exposure to the air and an allowance of two hours as a resting period between the final embodying and the spiriting.

To Repolish Woods.

In order to apply this process with facility, it will be needful to disunite the various parts of each article. If the job be a wardrobe, take off the doors by unfastening their hinges, remove all the screws, take off the cornice, lift the wings off the carcass from the base and then separate the mouldings and other carved ornaments from the frames and panels of the doors. Pull the drawers out, unscrew the knobs or handles, remove the escutcheons from the key-holes, free the pilasters from their recesses and lift the carcass from off the base. If the job is a sideboard, separate the upper back from the top, unscrew the under back and then take the base, top and pedestals asunder. After having disjoined the different portions and ornaments, take a pencil and put tally marks on every two meeting sides. This will guide you in having everything appropriately replaced when the complete article is finished. The viscid rust or sweated polish must be removed from the surface of the work. This is done by scrubbing it with a paste made of the finest emery flour and spirits of turpentine.

After cleaning and before repolishing, it is a good plan to merely moisten the face of the work with raw linseed oil, for this causes the old body to unite with the new one. Where shallow dents, scratches and broken parts of the polish present themselves, carefully coat them three times with a thick solution of shellac and when the last coatings become hard, rub them with soft putty until they become uniformly smooth and even; then proceed to polish the general surface.

To Polish Wood in the Lathe.

Soft wood may be turned so smooth as to require no other polishing than that produced by holding it against a few fine turnings or shavings of the same wood while revolving. Mahogany, walnut and some other woods may be polished by the use of a mixture as follows: Dissolve by heat so much turpentine and beeswax that the mixture when cold shall be about the thickness of honey. This may be applied to the furniture or work running in the lathe by means of a piece of clean cloth, and as much as possible should be rubbed off by using a clean flannel or other cloth. Hard woods may be turned readily smooth, fine glass paper will suffice to give them a very fine surface, a little linseed oil may then be rubbed down and a portion of the turnings of the wood to be polished may then be held against the article while it turns rapidly, which will in general give it a fine gloss. Also try 2 parts of alcoholic shellac varnish and 1 part of boiled linseed oil; shake well before using. Apply a small quantity with a cloth and rub vigorously until the polish is obtained.

To Polish Piano Keys.

The frame will not hold the keys sufficiently level or firm. A better way would be to handscrew a few at a time on a board and scrape them in that position. They should be finished with flour paper, care being taken that they do not get too hot during the process. Unless the keys are very hollow or much discolored it would perhaps be better to dispense with the scraper altogether, using a coarser glass paper in its stead. They should be polished singly on a board covered with several thicknesses of cloth, which should be placed on a bench and the ivories vigorously rubbed, lengthwise and face downwards, until a good polish is obtained. Putty powder is the best polishing material, though pumice might first be used to take out any marks left by the paper. A very brilliant polish may be got by finishing the keys with a similar board covered with wash leather and sprinkled with rouge. A liberal supply of water is necessary during the process.

To Polish Plaster of Paris Work.

Add to the gypsum 1% or 2% of alum, sulphate of potash or borax. The gypsum will set slowly and is capable of receiving a high polish.

Polishing Vulcanite.

No. 1.—Remove scratches with a smooth, wet, water-of-Ayr stone and then polish in the lathe with fine pumice and a stiff brush. After washing off the pumice, polish it with whiting and a soft brush.

No. 2.—Mathematical instrument makers treat it as they do brass. That is, for flat work they first use water-of-Ayr stone and then rotten stone and oil. Turned work is polished in the lathe with rotten stone and oil; too high a speed must be avoided as it would heat the vulcanite. Some use lampblack and oil to finish with where a very high polish is wanted, or the palm of the hand as in getting up silver plate. Chain and ornament makers use a circular buff for their flat work, made of "sea-horse" leather (rhinoceros hide), and for work of irregular form, buffs of calico.

DECORATING WOOD AND OTHER MATERIALS BY STAINING.

To Stain or Color Alabaster.

No. 1.—Mix various colored powders or solutions with the plaster at the time of mixing it up with the water. A little tierra di siena in very fine powder or ground with water, added to the water employed to mix up the plaster, imparts a pleasing color to busts, statues, medallions, etc.

No. 2.—Objects formed of the solid alabaster may be stained in the same way and with the same materials as marble.

To Stain Bricks.

No. 1.—For staining bricks red, mix 1 oz. of glue in 1 gallon of water, add a piece of alum the size of an egg, then $\frac{1}{2}$ lb. of Venetian red and 1 lb. of Spanish brown. Try the color on the bricks before using and change to light or dark with the red or brown, using a yellow mineral for buff.

For Coloring Bricks Black.

No. 1—Heat asphaltum to a fluid state, moderately heat the surface of the bricks and dip them.

No. 2.—Make a mixture of linseed oil and asphaltum, heat the bricks and dip them. It is important that the bricks should be sufficiently hot and be held in the mixture to absorb the color to the depth of $\frac{1}{4}$ inch.

Red Wash for Bricks.

Melt ½ oz. of glue in hot water. While hot, put in a piece of alum half the size of an egg, ¼ lb. of Venetian red and ½ lb. of Spanish brown. Try a little on the bricks. If the color is too light add more red; if too dark, more water.

To Stain Tortoise-Shell.

A rough dough is prepared from 17.5 oz. of white litharge, 2.2 lbs. of finely-powdered unslaked lime, 3.3 lbs. of soap-boiler's lye having the specific weight of 1.036. The places of the horn which are to become dark are covered with this dough, and the horn allowed to remain in contact with the dough for about 24 hours until the latter has become perfectly dry. The horn is then cleansed with a brush.

A Blue Stain for Marble.

Use a tincture or solution of litmus or an alkaline solution of indigo. Heat the liquid so that it will just simmer on the surface.

Wood Staining.

The best woods for staining are those of close-woven texture, as cherry, birch and maple. The wood should be perfectly dry, planed and sandpapered very smooth. Nearly all the stains are applied hot as this causes them to penetrate the pores of the wood more deeply. If the wood is to be varnished, many of the dyes used in coloring cloth may be employed in alcoholic solutions, but

the effect is not equal to the regular stain. In case the natural color of the wood prevents the wood being stained satisfactorily, bleach the wood by saturating with the following solution:

9 oz. of chloride of lime,
1 oz. of soda crystals,
2½ quarts of water.

The wood may be bleached in this for half an hour. Wash with a solution of sulphurous acid, then with water.

To Stain Wood Black.

No. 1.—Obtained by boiling together blue Brazil wood, powdered gall-apples and alum in rain or river water until it becomes black. This liquid is then filtered through fine organzine and the objects painted with a new brush before the decoction is cooled. This is repeated until the wood appears of a black color. It is then coated with the following liquid, a mixture of iron filings, vitriol and vinegar, which is heated (without boiling) and left a few days to settle. Even if the wood is black enough, yet for the sake of durability it must be coated with a solution of alum and nitric acid, mixed with a little verdigris, then a decoction of gall-apples and logwood dyes is used to give it a black color.

No. 2.—One ounce gallnuts broken into small pieces, put into barely ½ pint of vinegar, which must be contained in an open vessel, let stand for half an hour; then add 1 oz. of steel filings, the vinegar will then commence effervescing; cover up but not sufficient to exclude all air. The solution must then stand for about half an hour when it will be ready for use. Apply the

solution with a brush to the article, then let it remain until dry. If not black enough, coat it until it is; of course letting it remain sufficiently long to dry thoroughly. After the solution is made, keep it in a closely-corked bottle.

No. 3.—Campeachy wood, 250 parts; water, 2,000 parts, and copper sulphate, 30 parts. The wood is allowed to stand for 24 hours in this liquor, dried in the air, and finally immersed in iron nitrate liquor at 4 Beaume.

No. 4.—Boil $8\frac{3}{4}$ oz. of logwood in 70 oz. of water and 1 oz. of bluestone, and steep the wood for 34 hours. Take out, expose to the air for a long time and then steep for 12 hours in a beck of iron nitrate of 4 Beaume. If the black is not fine enough, steep again in logwood liquor.

No. 5.—Almost any wood can be dyed black by the following means: Take logwood extract such as is found in commerce, powder 1 oz. and boil in $\frac{3}{4}$ pint of water. When the extract is dissolved add 1 drachm of potash bichromate and agitate the whole. The operation is now finished and the liquid will serve equally well to stain wood. Its color is a fine black when applied to the wood.

No. 6.—For black and gold furniture, procure 1 lb. of logwood chips and 2 quarts of water; boil one hour, brush the liquor in hot; when dry give it another coat. Now procure 1 oz. of green copperas, dissolve it in warm water, mix well and brush the solution over the wood. It will bring out a fine black, but the wood should be dried outdoors as the black sets better. Now procure,

say, 1 gill of French polish, in which mix 1 oz. of ivory black, or gas black is best (see following recipe). Shake it until quite a thick pasty mass, procure ½ lb. of best hard varnish, pour a portion into a cup, add enough polish to make it quite dark and then varnish the work. Two thin coats are better than one thick one. The first coat may be glass-papered down where accessible, as it will look better. A coat of glaze over the whole gives a "London" finish.

For a Table.

No. 7.—Wash the surface of table with liquid ammonia applied with a piece of rag; the varnish will then peel off like a skin. Afterwards smooth down with fine sandpaper. Mix ½ lb. of lampblack with 1 quart of hot water, adding a little glue size. Rub this stain in well, let it dry before sandpapering it smooth again. Afterward apply the following black stain with a broad, fine camel's-hair brush. Mix a small quantity of gas black with the varnish. A black can be obtained by boiling a pot over the gas, letting the pot nearly touch the burner, when a fine jet-black will form on the bottom, which remove and mix with the varnish. Copper vessels give the best black. It may be collected from barbers' warming pots.

No. 8.—Sponge the wood with a solution of aniline chlorohydrate in water, to which a little quantity of copper chloride is added. Allow it to dry and go over it with a solution of potassium bichromate. Repeat the process two or three times and the wood will take a fine black color.

Brown Stain.

No. 1.—Various tones may be produced by mordanting with potash chromate and applying a decoction of fustic, of logwood or of peachwood.

No. 2.—Sulphuric acid more or less diluted, according to the density of the color to be produced, is applied with a brush to the wood, which is previously cleaned and dried. When the acid has acted sufficiently, its further activity is arrested by the application of ammonia.

No. 3.—Tincture of iodine yields a fine brown coloration, which, however, is not permanent unless the air is excluded by a thick coating of polish.

No. 4.—A simple brown wash is ½ oz. of alkanet root, 1 oz. of aloes, 1 oz. of dragon's blood, digested in 1 lb. of alcohol. This is applied after the wood has been washed with aqua regia, but is, like all the alcoholic washes, not very durable.

Cherry or Crimson Stain.

25 grains of alkanet root,
30 grains of aloes,
30 grains of dragon's blood,
500 grains of 95% alcohol.

Mix and let it stand in a tightly-corked bottle some days. Go over the wood with dilute (1 to 10) nitric acid first. This is pretty dark. You may lighten by using more alcohol.

Red Stain for Bedsteads and Common Chairs.

Archil will produce a very good stain of itself when used cold, but if, after one or two coats being applied and suffered to become almost dry, it is brushed with a hot solution of pearlash in water, the color is improved.

To Give the Appearance of Age.

No. 1.—Boil ½ lb. of madder and 2 oz. of logwood chips in a gallon of water and brush well over while hot. When dry, go over the whole with pearlash solution, 2 drachms to the quart.

No. 2.—Boil ½ lb. of logwood in 1 pint of water and add ½ oz. of salt of tartar. Stain the wood with the liquor boiling hot.

No. 3.—Boil ½ lb. of madder and ¼ lb. of fustic in 1 gallon of water; use hot as before.

Ebonizing.

Boil 1 lb. of logwood chips one hour in 2 quarts of water. Brush the hot liquor over the work to be stained and lay aside to dry. When dry, give another coat, still using it hot. When the second coat is dry, brush the following liquor over the work: 1 oz. of green copperas to 1 quart of water, to be used when the copperas is all dissolved. For staining, the work must not be dried by fire but in the sunshine. If this is not convenient, then in a warm room away from the fire. To polish this work, first give a coating of very thin glue size and when dry smooth off very lightly with number 0 paper only just enough to render smooth but not

to remove the black stain. Then make a rubber of wadding about the size of a walnut, moisten the rubber with French polish, cover the whole tightly with a linen rag, put one drop of oil on the surface and rub the work with a circular motion. When the work has received one coat, set aside to dry for about an hour. After the first coat is laid on and thoroughly dry, it should be partly papered off with number 0 paper. This brings the surface even and at the same time fills up the grain. Now give a second coat as before. Allow 24 hours to elapse, again smooth off and give a final coat as before. Now comes spiriting off; great care must be used here or the work will be dull instead of bright. A clean rubber must be made, as previously described, but instead of being moistened with polish it must be wetted with 90% alcohol, placed in a linen rag screwed into a tight, even-surface ball, just touched on the face with a drop of oil and then rubbed lightly and quickly in circular sweeps all over the work from top to bottom.

For a fine black ebony stain, apple, pear and hazel woods are the best to use. When stained black, they are most complete imitations of the natural ebony. For the stain, take 14 oz. of gall-apples, $3\frac{1}{2}$ oz. of rasped logwood, $3\frac{1}{4}$ oz. of vitriol, $1\frac{3}{4}$ oz. of verdigris. For the second coating, a mixture of 3 oz. of iron filings dissolved in $1\frac{1}{2}$ pints of strong wine vinegar, is warmed, and when cool, the wood, already blackened, is coated two or three times with it, allowing it to dry after each coat. A strong lye is now put into a suitable pot to which is added coarsely-bruised gall-apples and blue Brazil shavings, and exposed for the same time as the

former to the gentle heat of an oven which will then yield a good liquid. The woods are now laid in the first-named stain, boiled for a few hours and left in it for three days. They are then placed in the second stain and treated as in the first. If the articles are not thoroughly saturated, they may be once more placed in the first bath; then in the second. The polish used for wood that is stained black should be white (colorless), to which a little finely-ground Prussian blue should be added.

To Stain Floors.

No. 1.—Get the wood clean, have some Vandyke brown and burnt sienna ground in water; mix it to a strong size, put on with a whitewash or a new brush as evenly as you can. When dry, give two coats of copal or oak varnish.

No. 2.—If the floor is a new one, have the border well washed, polish with glass paper, rubbing always with the grain of the wood. Cover with good oak varnish. Put coloring matter into the varnish to suit your taste, but umber is best. If the floor is old and blackened, paint it.

To Stain Beech a Mahogany Color.

Put 2 oz. of dragon's blood, broken in pieces, into a quart of 90% alcohol. Let the bottle stand in a warm place and shake it frequently. When dissolved, it is fit for use.

Imitation of Mahogany.

Plane the surface smooth and rub with a solution of nitrous acid. Then apply with a soft brush, 1 oz. of

dragon's blood dissolved in about 1 pint of alcohol and with one-third of an oz. of carbonate of soda, mixed and filtered. When the brilliancy of the polish diminishes, it may be restored by the use of a little cold-drawn linseed oil.

To Darken Oak.

Give it an application of strong liquid ammonia by means of a sponge or brush. The tannic acid in this wood causes it to darken immediately and the color does not fade. Bichromate of potash dissolved in a small quantity of water and applied in a similar manner, will produce the same results. Some German cabinet makers use very strong coffee for darkening oak.

To make oak very dark, iron filings mixed with a little water and sulphuric acid, and applied with a sponge, will produce any shade of darkness on oak, according to the number of applications. Allow each coat to dry before applying the next.

Another process is to lay on a coat of ordinary whitewash made from fresh lime and when dry and hard, brush off with a stiff brush and have an application of linseed oil given to the wood. This process should be done after the wood has been worked. By this process new oak can be made to look like old wainscot oak.

An application of a strong solution of common washing soda will darken oak. It should be sandpapered afterwards and then oiled.

The application of a decoction of green walnut shells will bring the color of new oak to any shade required, even black.

A Brown Stain On Oak.

A brown stain on oak is produced by the application of a solution prepared by boiling 1 oz. of caoutchouc (gambier) in 30 fluid oz. of water. When this has dried on, brush the wood with a solution of bichromate of potash made by dissolving 1 oz. of the bichromate in 1½ pints of water.

Equal parts of American potash and pearlash will give a good oak stain, about 2 oz. of each to the 1½ oz. of boiling water. Use this fluid on a mop or sponge tied to a stick as it blisters the hands, owing to its causticity; dilute with water if necessary.

To Produce Walnut Stain.

No. 1.—Light Walnut.—Dissolve 1 oz. of permanganate of potash in 30 oz. of water and apply twice in succession. After an interval of five minutes wash with clean water and when dry oil and polish.

No. 2.—Dark Walnut.—Same as for the light walnut, but after the washing with water, the dark veins are made more prominent with a solution of acetate of iron applied skilfully with a thin camel's-hair brush or pencil.

To Stain Pine a Walnut Color.

Put 2 oz. of privet berries in ½ pint of liquid ammonia and apply to the wood, whether it be varnished or polished. It will produce the color of real walnut so closely as to be difficult to detect from that article.

Take 1 gallon of very thin size shellac; add 1 lb. of dry burnt umber, 1 lb. of dry burnt sienna and 4 oz. of

lampblack. Mix well these ingredients by sifting together, then add them to the shellac size. Apply one coat with a brush. When dry, rub down with fine glass paper and apply one coat of shellac or cheap varnish. It will then be a good imitation of solid walnut. This is adapted for the backboard of mirror frames, the back and inside of casework, etc.

To Darken Walnut.

One part of slaked lime mixed with 4 parts of water will darken walnut. A solution of sulphate of iron or a weak solution of pearlash also serves the same purpose.

To Impart a Rosewood Color to Walnut.

Dissolve one-fifth of an oz. of bichromate of potash in 1 oz. of water and apply the solution with a sponge, then pumice stone the wood and oil it.

To Stain Common Deal or Pine a Walnut Color.

These woods, also birch, can be made to appear as if veneered with walnut. Dissolve 3 oz. of manganate of potash and 3 oz. of manganese sulphate in 5 oz. of water and give the wood several applications with a brush. The potash manganate is decomposed when it comes in contact with the woody fibre and thus a beautiful and very durable walnut color is obtained. If small wooden articles are to be stained in this manner, a very dilute bath is prepared, the articles dipped in it and kept there one to nine minutes, according as the color is desired darker or lighter.

A Simple Walnut Stain for Soft Woods.

Boil together ½ oz. of common washing soda, 2½ oz. of Vandyke brown, ¼ to ½ oz. of potassium bichromate in 1 quart of water, replacing the water that is lost by evaporation. Use hot and allow the work to dry thoroughly before oiling or polishing.

Walnut Stain for Hardwood Furniture.

Dissolve 2 lbs. of genuine asphaltum in 1 gallon of spirits of turpentine and apply with a brush or sponge. Only a thin solution is required.

Dragon's blood and lampblack mixed with wood alcohol may be used to impart the color of walnut to woods, whether hard or soft.

Mix and apply with a brush a solution made of 1 gallon of strong vinegar, 1 lb. of dry burnt umber, ½ oz. of rose pink, and ½ lb. of dry burnt Vandyke brown.

To Produce a Rosewood Color.

Boil 1 lb. of logwood chips, ½ lb. red sanders wood in ½ gallon water, and coat the wood with this, then go over it with the asphaltum in turpentine.

Staining Wickerware.

All osiers take stains remarkably well, but to cause the stain to penetrate well into the wood, so as not to be bleached when exposed to the air, the wood should be first mordanted with lime water, which is easily prepared by slaking freshly burnt lime with tepid water

until it falls to a fine powder, and stirring 1 pint of this powder with 15 to 20 pints of soft water, allow it to settle, and then pour off the fluid from the deposit. The fluid thus poured off is put into a suitable vessel, and the osiers or wickerware steeped in it for 1 to 6 hours, then they are taken out and dried at 96 to 104° Fahr. Before the ware-wood becomes cold, the stain is applied either with a brush or by steeping the wickerware in the fluid stain; sometimes the osiers are stained before being made into wickerware. Brown stains are usually chosen for wickerwork, but practically any color can be imparted to it, and any lettering or device can be applied by staining the white wood.

No. 1.—Brown Stain.—Dissolve 1 oz. of permanganate of potash in 5 pints of water, and dip the wickerware into the fluid, lift out at once, and allow the ware to drain. By this means a pale brown color is obtained, but by allowing the wickerware to remain from $\frac{1}{4}$ to several hours, various darker tones can be obtained.

No. 2.—Dissolve $4\frac{1}{2}$ oz. of potash in 5 pints of water, and steep the wickerware in this fluid for 2 hours, then boil it for 2 hours in a boiling hot solution of pyrogallic acid, made by dissolving $2\frac{1}{4}$ oz. of this acid in 5 pints of water.

No. 3.—Dissolve $3\frac{1}{2}$ oz. of catechu and $1\frac{1}{2}$ oz. of soda crystals in 5 pints of water by boiling, and steep the wickerware in the fluid for 3 or 4 hours, then dry it and afterward steep it for 1 hour in a solution of 5 oz. of bichromate of potash in 5 pints of water.

Blue.—This stain is imparted by dissolving 2 oz. of

indigo carmine in 1 quart of water and soaking the wickerware in the fluid for 5 or 6 hours.

Green.—Dissolve 2 oz. of indigo sulphate and 1 oz. of picric acid in 50 oz. of boiling water, and steep the wickerware in the fluid for several hours. Different tones of green are obtained by altering the relative proportions of the above coloring matters.

Yellow.—These stains are obtained by dissolving 1 oz. of picric acid in 5 quarts of boiling water, and steeping the wickerware in the fluid for 2 hours.

Brown or Black on Wickerware.

The above bright colors are best obtained on the white or uncolored wickerware. If it has become travel-stained or soiled through constant use, it is best to renovate the soiled case by staining it brown or black. Either of the following will produce a good black, provided all grime has been washed off the wickerware.

No. 1.—Dissolve 1½ pounds of aniline nitrate and 1 oz. of cupric chloride in 9½ gallons of water. Boil the wickerware in the fluid for 1 hour, then put it in a boiling hot solution of potash bichromate for ½ hour, 8½ oz. of bicarbonate per gallon of water.

No. 2.—Boil 25 oz. of logwood extract in 12½ pints of water and 1-5 oz. of alum, strain or filter the fluid, and then steep the wicker in the fluid for 2 to 6 hours.

Keep the liquid at the boil all the time, then remove the wickerware and dry, then steep in a boiling hot solution (from 2 to 4 hours) of 15 oz. of sulphate of iron

in 7½ pints of water. This produces a more or less bluish black with a grayish cast, but by steeping in a decoction of 13 oz. of cupric sulphate in 1¼ gallons of water, a deeper black is obtained.

Gray.—In the case of new wickerware, it will be found that by coloring it a gray tone, dirt and grime will not show so readily as with unstained wood. A good gray tone is obtained by dissolving 45 oz. of sulphate of iron (green copperas) in 7½ pints of cold water, and steeping it well in it for 2 to 6 hours, and then, after drying, in a decoction of 1½ pounds of pyrogallic acid in 5 pints of water. The gray color produced will not look so funereal as black, and at the same time will disguise the effect of dirt and grime.

Aniline Colors.

These aniline dyes are much more effective than the above coloring matters, as these dyes attack organic fibres, such as wood, directly it comes in contact with them, so that there is no necessity for prolonged steeping. In fact, the staining fluid can be applied with a brush or sponge. For bright colors, aniline colors are best to use. In using aniline colors, the wood must not be mordanted with lime water, because that, in many cases, would discharge the color of the dye. The best mordanting process is to dissolve 6 oz. of Marseilles soap in 12½ pints of boiling water, soak well the wickerware in the solution and dry before applying the dye liquor. The aniline dyes used should be those soluble in water. It is best to dissolve the dye in water of 86 to 140° Fahr. Stir well and then steep the wickerware

in the dye liquor until colored deep enough. As the dye liquor becomes exhausted, it should be strengthened by the addition of some freshly made dye solution. The quantity of dye to use is very small. The following formulas will show the quantity to use:

No. 1.—Blue.—Dark. Dissolve 3 oz. of Bengal blue in 3½ pints of boiling water, and stir or filter the fluid in 10 minutes' time.

No. 2.—Light. Dissolve 3 oz. of blue de lumiere in ½ gallon of boiling water.

No. 3.—Sky Blue. Dissolve 3 oz. of blue de ciel in ½ gallon of boiling water.

No. 4.—Greenish Blue. Dissolve 3 oz. of blue de vert in ½ gallon of water.

No. 1.—Green.—Dark. Dissolve 3 oz. of methyl green, ½ oz. of blue de lumiere, ½ gallon of hot water.

No. 2.—Light. Dissolve 1 oz. of methyl green, 1 pint of boiling water.

Red.—Dissolve 3 oz. of coral red, 5 pints of water.

Dark Red.—Dissolve 3 oz. of fuchsine, 1 oz. of orange and 5 pints of water.

Rose Red.—Dissolve 3 oz. of rose Bengal and 5 pints of water.

Violet.—Dissolve 3 oz. of methyl violet in ½ gallon of water.

Reddish Violet.—Dissolve 3 oz. of methyl violet, 1 oz. of fuchsine and ½ gallon of water.

Golden Yellow.—Dissolve 3 oz. of naphthaline yellow and ½ gallon of water.

Brown.—Dissolve 3 oz. of Bismarck brown and ½ gallon of water.

Chestnut Brown.—Dissolve 1 oz. of maroon and 1 pint of water.

Finishing the Ware.

There are many other stains, but the above will indicate the proportion. The quantities specified produce a very concentrated stain. If any more dye were used, the liquid will produce bronzed effects. It is best to make up the dye liquor with the quantities specified, then to take a pint or quart of it and dilute with more or less water to produce sufficient dye liquor for the wickerware to be steeped in. As the dye liquor loses strength it should be fortified by the addition of more of the original dye solution.

After the wickerware is dry and dyed, it should be given a coat of varnish or lacquer made as follows, but first dip the ware in a thin solution of hot white glue or gelatine, and allow it to dry. This will close the pores and take the varnish smoothly. For white ware, the colorless spirit varnish is needed. For dark ware, a mixture of light and dark brown spirit varnish or quick drying copal varnish is advised. For black, spirit lacquer should be used.

As it is becoming a prevailing custom for makers of light dinner beverages to supply them in 1- and 2-gallon jars, wicker covered and fitted with a faucet, it will be found to the advantage of the manufacturer to have the wicker cases stained and varnished. He will thus preserve them from damp, at the same time make them look presentable and permit of them being cleaned more readily than if left in the natural white state.

MISCELLANEOUS DECORATING PROCESSES.

Decorating Glass, Etc., With Prints.

To transfer prints to polished steel or to glass, make a varnish as follows: Digest in a bottle:

4 oz. of sandarac resin,
1 oz. of Venice turpentine,
15 oz. of alcohol.

Moisten the print slightly on the back by laying a wet cloth upon it. Then varnish the steel plate or glass with a thin, even coat of the above varnish. Lay the print with the face next to the varnish, commencing on one side so as not to inclose air bubbles, pressing down with the fingers if the print is small or using a soft roller if the print is large. Be careful that all parts of the print are in contact with the varnish, then lay aside to dry. After it is dry, wet the back with water and cautiously rub the paper off with the fingers. Rub lightly towards the last with plenty of water and the surface of the varnish will come up smooth with the ink of the print solidly embodied. Then a thin coat of mastic varnish will give it a finish.

No. 2.—First coat the glass with dammar varnish or with Canada balsam mixed with an equal quantity of turpentine. Let it lay until it is very sticky, which takes half a day or more. The printed paper to be

transferred should be well soaked in soft water and carefully laid upon the prepared glass, after removing surplus water with blotting-paper and pressing upon it so that no air-bubbles or drops of water are seen beneath. This should dry a whole day before it is touched. Then, with wetted fingers, begin to rub the paper lightly at the back. If this be skilfully done, almost the whole of the paper can be removed, leaving the ink simply upon the varnish. When the paper has been removed, another coat of varnish will serve to make the whole transparent.

Pasteboard, to Dye.

To give white pasteboard the color of leather, soak in a solution of copperas and then in ammonia.

Pearl Buttons, to Dye.

Wash with a lukewarm solution of potash, then place in a strong aqueous solution of the desired color and let them remain with frequent stirring in a warm place. To cause the color to penetrate, an immersion of two weeks may be needed. Use aniline colors.

To Preserve Photographic Negatives.

Put ½ pint of chloroform into a bottle and add 1 oz. of dammar, ½ oz. of mastic and ¼ oz. of sandarac resin, all in fine powder. Then add ½ pint of varnish oil, shake up well together and then stand the bottle in a sand bath until the solids are dissolved. Filter the fluid through cotton-wool in a china or glass funnel and

keep in a well-stoppered bottle. It is laid on the film side of the negatives to keep them from injury.

Iridescent Glass.

The manner in which the glass is to be made iridescent is due to when it has been given the lightest degree of heat. The following mixture is introduced into the annealing chamber through an aperture: 1 part of carbonate of barytes, ½ part of strontium and 2 parts of tin salts. The vapors which are developed produce the lustre. Strontium gives red, barytes blue, and the tin salt, various colors.

Photochromotypy.

This is a process of producing impressions of leaves and plants and is effected as follows: The plant is first dried and flattened by pressure between unsized paper or it may be done rapidly with a hot iron. The surface to be copied is then brushed with a solution of aniline color in alcohol and allowed to dry, which will take place very rapidly. If the impression is to be taken on paper, immerse the latter in water for a few seconds and remove the excess by pressure between blotting-paper. Place it then on some non-absorbent surface and apply the plant, colored side down. While it is held securely in position, stamp the whole surface with a wad of cotton. A cold iron may be placed over the paper instead of using the cotton, and if a few sheets of tissue paper are interspersed between the paper and plant, its outline and veins principally will be copied. If the paper which is to receive the impression is moistened

with alcohol instead of water, the impression will be brighter and the paper will retain its lustre or gloss better. If a very light coating of glycerine be spread on the colored plant when perfectly dry and the excess removed by unglazed paper, one or more prints may be taken upon dry paper or other dry surface. If the print shows blots when a strong color is used, pass over the surface a solution of nitrate of potash, which will moderate the impression. Parts of plants may be colored differently to conform to nature or individual taste. Defects may be touched up with a pen dipped in the color.

Crystal Ornaments.

By suspending a bundle of small twigs, ears of corn, moss roses, a hyacinth, etc., in a saturated solution of alum or other salts, the article will become covered with a mass of crystals in a form that makes a very pretty ornament which if kept under a glass shade will retain the crystal form indefinitely. The following processes are carried out to produce these ornaments:

No. 1.—Dissolve 18 oz. of alum in 1 pint of water, boiling it in a closed tin vessel over a moderate fire and keeping it stirred with a stick of wood until the alum has dissolved. Then allow the liquid to become almost cold, but before it is quite cold, suspend the article to be crystallized in the solution. The solution is best put in a jar with a wide mouth and the article suspended by means of a thread from a stick of wood or a wire laid across the jar. The articles should remain in the solution 24 hours, when they are taken out and suspended in the shade until they are quite dry. The

process of crystallization is best conducted in a cool situation. When the objects to be crystallized are put into the solution while quite cold, the crystals are apt to be formed too big; on the other hand, should it be too hot, the crystals will be small in proportion. The best temperature is about 95° F.

No. 2.—Dissolve separately in tumblers of water, ½ oz. each of sulphate of alumina, sulphate of copper, sulphate of soda, sulphate of potash, sulphate of zinc, sulphate of magnesia and sulphate of iron. When dissolved, pour all the solutions together into an evaporating dish and mix well with a glass rod. Place the dish in a warm place where it cannot be affected by dust and where it is not liable to be agitated. When evaporation has taken place, the whole will begin to shoot out into crystals. Their color and peculiar form of crystallization will distinguish each crystal separately, and the whole together will display a very curious and pleasing appearance. Preserve carefully from rust.

Preservation of the Natural Colors of Flowers.

No. 1.—A method of preserving the natural colors of flowers consists in dusting salicylic acid on the plants as they lie in the press and removing it again with a brush when the flowers are dry. Red colors in particular are well preserved by this agent. Another method of applying the same preservative agent is to use a solution of 1 part of salicylic acid in 14 parts of alcohol by means of blotting-paper or cotton-wool soaked in it and placed above and below the flowers. As an improvement in the method of using sulphuric acid for preserving the

color, as in the case of delicate flowers, they may be placed loosely between sheets of vegetable parchment before immersion in the liquid, so as to preserve their natural form.

No. 2.—Insert the stems in water in which 25 grains of ammonium chloride (salammoniac) have been dissolved. Flowers can be preserved in this way for 15 to 30 days. To preserve them permanently for several months, dip them into limpid gum water and then allow them to drain. The gum forms a complete coating on the stems and petals and preserves their shape and color long after they have become dry.

Flowers in water can be preserved for about two weeks by putting a little nitrate of potash or carbonate of soda in the water in which the flowers are left standing.

INDEX.

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